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A Criticism of Degrees.

PROFESSOR R. G. STAPLEDON'S work on all aspects of grassland development is well known, and his recent book *The Land*: *Now and To-morrow*, indicates that he sees his problems against the background of a nation's life. In the January issue of *Science Progress* we find a stimulating article from his pen "Agricultural Research and Higher Degrees". The article is well worth consideration by Fellows of university senates, professors teaching post-graduate students, or members of selection boards. While the author deals with agricultural research mainly, his remarks apply to other higher degrees and, in fact, to the degree system.

As an introduction, Prof. Stapledon deals with the nature of agricultural problems and the way they should be solved. One would like to quote this in full, but some short extracts must suffice:

"The amount of high-class and intricate research that must be undertaken with ultra-practical aims in view is probably far greater than is fully realised by either the research workers themselves or by those who administer research funds. This is realised far more fully by the farmer who, as a matter of fact, is always posing difficult conundrums to the scientist—conundrums, because of the soil and of agriculture, so difficult that it is seldom within the competency of a single specialist (the botanist, the chemist or the veterinarian) adequately to answer, or, in the majority of instances, to formulate a line of research most likely to lead to the correct and practical solution."

"The problems of agriculture to a greater extent probably than of any other applied science are of an omnibus nature—in the sense that they are seldom within the province of any one department of science fully to solve."

"Two extraordinarily important facts follow from all this, both of which have a fundamental bearing upon the training of the men who are to become competent research workers in the agricultural field. In the first place, almost more important than the actual solving of problems is the predetermination of the problems which, in fact, it is desirable to solve."

"The truth is the successful agricultural research worker ('successful' as here predefined) needs to develop a certain sense and feeling towards his subject; for without that

he will never be able properly and in detail to pre-define his problems. As well as the sense and feeling, however, he must have the technical equipment of the best pure scientist in the particular field that he wishes to make his own. More than all this, he must have that state of mind that makes it come natural to him to place all his cards on the table and to work gladly and enthusiastically as a member of a team."

Having thus defined agricultural problems and the conditions of their solution, the author then considers the case of the M.Sc., the Ph.D. and the D.Sc. degrees in their relation to the making of a real research worker in agricultural science. The author points out that the M.Sc. degree can be variously obtained and hence the degree does not imply any particular standard of attainment nor does the holding of the degree necessarily mean that the recipient has undergone any rigorous and supervised training in research. The thesis demanded for the degree may be presented by a young man doing post-graduate work immediately in continuation of his honorary degree and is perhaps most generally presented by men who already hold posts in a teaching or research department. In the latter case, the candidate, if on the staff of a research department or institution, may have been engaged in team-work. The presentation of a thesis under sole authorship is hardly compatible with the highest ideals of the team spirit.

The Ph.D., unlike the M.Sc., is, says Professor Stapledon, intended only for students who pass straight on from graduating to undertake a prescribed piece of research under supervision. The fact that the man who gains this degree is called 'Doctor' and that in the eyes of the uninitiated the profound difference between the D.Sc. and the Ph.D. as a qualification is not known, is a drawback. Moreover, the period allowed for preparation for the Ph.D. is usually two sessions, and Professor Stapledon points out that even if this period were extended to two full years it does not, certainly in the case of grassland science, give enough time for the conduct of a piece of research sufficiently widely based adequately to train a man in the research methods applicable to a subject so wide. The inevitable result is that the only way to deal with a Ph.D. candidate in these wide subjects is to put him on to some tiny fragment of a worthwhile problem, or to make over to him a mass of existing material that is being studied by a senior man or by a group of men in the particular department. In the larger out-of-door subjects, therefore, the author says it is practically impossible as matters stand to accept, with a clear conscience, candidates for the PH.D. He goes on to remark that for a man who seeks only training and is not hampered by the restriction implied in the ultimate preparation of a thesis for a degree, two years is a sufficient time to give excellent training to a man interested in grassland problems. His general findings regarding these three degrees may be noted :—

"The agricultural scientist cannot be separated in treatment from other applied scientists, and the applied scientists cannot in equity be separated from the pure scientists, but it would probably be better for all if higher degrees granted on the thesis basis were completely abolished. The Ph.D. has served no really useful national purpose, and has carried with it innumerable psychological effects which have done neither the young doctors nor the universities any good, and should be abolished root and branch. The M.Sc. is perhaps more innocent, despite the fact that it stands for too wide a range of attainment and qualification, and of research training. Because many of the candidates for the M.Sc. already hold research positions, if this degree is to be retained the submission of papers or thesis of joint authorship should be considered as a merit and be definitely encouraged instead of being disallowed, for ability to collaborate is one of the outstanding necessities of the modern scientists.

The D.Sc. stands in a different category, because it does not influence a man's training. It may, however, influence a man's attitude towards team-work and collaboration, and may so influence his attitude over a long run of years, during which time he is himself in a senior and influential position, and therefore, capable of considerable psychological mischief to the man himself, and therefore also of considerable mischief to the spirit that should animate a research institution."

Whether we agree or not with these final conclusions, there are many of us who would echo the remarks regarding the

narrowness of training which must perforce be given for the Ph.D. and the consequent inadequacy of men so trained for a broad outlook on research problems. What can be expected, for example, from a candidate who has devoted two years to nothing but the study of the alimentary system of some unimportant insect? Has he been trained in such a way that as a future Agricultural Entomologist his degree is a hall-mark of real usefulness?

It is always difficult for universities to make reforms within their own borders and yet that is the only place from which university reform can start, and if the clear thinking which ought to be associated with universities is applied to this question of post-graduate degrees and their values, then we ought to see some improvement both in the training given for such titles and in their real value.

W. B.

The Age of the "Indus Valley Civilization".

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IN recent years so much vague speculation appeared in the Press on the age of the so-called Indus Valley Civilization (a term that I shall keep provisionally, lacking something better) that it is, I believe, time to sum up the discoveries of recent years on the subject, especially in view of the fact that many of the speculators are not aware of the evidence that has been accumulating outside India. Though much that can be said now about the age of the materials at hand, is still subject to correction, it must be understood, and will be proved in this article, that the main outlines are correct and final; minor adjustments are necessary and possible, and, more than that, most likely. Revolutionary changes, however, are quite unlikely to turn up.

The present article, brief as it is, is mainly a summary, and contains little original matter. One or two discoveries made recently (in 1937) and published in preliminary reports, will be included for the first time in such a discussion; the rest ought to be known to serious students of the chalcolithic period of India.

Recent evidence can be summed up as follows:—

(*a*) Eighteen Indian seals found in Mesopotamia in ancient sites and described by Mr. Gadd (see list of all articles and books referred to at the end of this paper);

(*b*) Frankfort's discoveries of seals, amulets, pots, and inlay-pieces at Tell Asmar, described in *An. Bibl. I. A. 1932*;

(*c*) One whole scarlet-ware pot and several fragments found in 1937 by Frankfort in Tell Asmar, described in *Ill. London News*;

(*d*) A Sumero-Babylonian inscription discovered by myself at Mohenjo-daro, described in *Ind. Culture*;

(*e*) The discovery of the detailed connexion of bull-worship and bull-sacrifice as between India and Crete (by myself, *An. Rep. Arch. Survey*) and the connecting link in Syria, described by M. André Parrot in *Ill. London News*;

(*f*) Inner evidence from recent excavations at Harappa and Chanhu-daro (mostly unpublished).

Starting with the last group of materials first, it must be made clear that there is a tremendous amount of material so far unpublished, relating to discoveries at Harappa and Mohenjo-daro. Most recent writers still refer to the few skulls examined after the excavations at Mohenjo-daro, whereas a great amount of skeletal remains have since been discovered in Harappa and examined by anthropological experts. It is not the task of this article to discuss the ethnic character of the peoples of that period, and it should suffice to say that recent examinations support the view that the skeletons belong to a very varied mixture of races. As to Chanhu-daro, Dr. Mackay has published much of his materials. At this place the Indus Valley Culture continued for a few generations longer than at Mohenjo-daro or Harappa, and everything points to the fact that copper became more and more common with every generation. We are, thus, at the very end of the Stone Age, and it is entirely impossible to push the date of this culture back to some hoary age. On the other hand, neither at Chanhu-daro nor at any other

site of this civilization has iron been found. This, thus, gives the lower limit, as iron was known everywhere in the Middle East in the latter half of the second millennium. Iron is clearly connected with the appearance of Aryan people in the East; it is known in Iran round 2000 B.C., and it was known and often mentioned in the *Rgveda*. There is, consequently, a vast gap between the civilization of the stone-copper people and that of the iron-using people, who followed the former ones. There are also many other differences, which it is not our task to mention here in detail. Enough is said if I remind the reader that *the stone-copper people* of Mohenjo-daro, Harappa, Chanhu-daro, Ur, Tell Asmar, etc., were *agriculturist town-dwellers who buried their dead*, whereas *the iron-using Aryan-speaking people* were *hunters, warriors and unsettled nomads* who cremated their dead. No greater difference between the two types of culture can be conceived than that.

Another important fact that stands out clearly as a result of the Chanhu-daro excavations is the close resemblance of this culture with that of the Western city-cultures of Ur, Kish, Tell Asmar, etc. It is now evident that there were many differences in detail; but the essential features of these cultures were identical. In both areas the culture of the people was distinguished by the following outstanding features:

(*a*) the people lived, the first time in history, in ordered towns;
(*b*) they made burnt bricks;
(*c*) they used the potter's wheel;
(*d*) they used wheeled carts;
(*e*) they used stone and copper simultaneously;
(*f*) they started expressing complicated ideas in written symbols and gradually evolved a script;
(*g*) they knew glass;
(*h*) they knew faience;
(*i*) they used engraved stone seals, often with texts;
(*j*) they were agriculturists;
(*k*) they were cleanly people, with baths and drainage in their towns;
(*l*) they worshipped tree-spirits;
(*m*) they sacrificed bulls and bullocks;
(*n*) they believed in a god with horns;
(*o*) they had a legend of a Hero who fought with Lions;
(*p*) they had an astrological myth in which Leo fought with Taurus;
(*r*) they had an extensive trade with foreign countries and imported many commodities, especially precious metals and stones;
(*s*) they buried their dead (did not burn them like the Aryans) and deposited with them their utensils;[1]
(*t*) they manufactured beads;
(*u*) they made much use of shell and ivory;
(*v*) they made boats with an upper central structure;
(*w*) they employed asphalt (bitumen) as a binding agent for brickwork;
(*x*) they painted their pottery in black and polychrome paint, and used two characteristic colours, "plum" and "scarlet";
(*y*) they made incized steatite vessels with "basket-work design";
(*z*) they believed in a Sacred Mother Goddess whose symbols were the Dove and the Tree.[2]

It must be evident to every reasonable thinker that two such similar cultures must be contemporary. Hence, in fixing the date of the Indus Culture, every scholar must make a detailed study of the chronology of Western Asiatic civilizations of the same period.

This is now the more imperative, since Sir Aurel STEIN discovered the Caravan Road that connected India in the chalcolithic period with the Mesopotamian culture-area. All across Iran, in a connected line from the Indian Baluch frontier to the frontiers of Elam, there is a string of prehistoric sites, showing that in the period between 4000 and 2000 B.C., roughly calculated, there was a high road by which these two centres communicated with each other and exchanged each other's much coveted wares (see Bibliography at the end of this paper, under STEIN and FÀBRI).

The idea that the Indus Civilization was something isolated and unique, must be discarded as entirely impossible. Though it has definite individual features, it has sister civilizations elsewhere.

The close connexion of these two culture-areas is also clearly proved by the considerable number of seals from India discovered

[1] Post-cremation burials are, of course, known at Harappa, alongside with four other methods of disposal of the dead.

[2] There are, of course, many other points of similarity.

at Mesopotamian sites. GADD's article referred to above mentions eighteen seals; not all of these are accurately datable or found in context with other, better datable, Sumerian finds. But a few of them are, and not one of them can be older than 2800 B.C., though probably they are a hundred or a two hundred years younger than that date. The most important and most accurate finds in this category are those made by FRANKFORT at Tell Asmar. Ample reference to these have been made by the writer of these lines in his paper *A Sumero-Babylonian Inscription discovered at Mohenjo-daro.* The essence of the evidence may be summed up thus: all the objects found by FRANKFORT are clearly of Indian origin, depicting, among others, in true Mohenjo-daro style animals that never existed in Mesopotamia but were well known in India; and as these objects were found in a perfectly well datable layer of the time of the Dynasty of Akkad, the uppermost limit of their age is 2500 B.C.; but they are quite likely to be a generation or two younger than that. No scholar who is interested in the chronology of the Indus Culture should miss reading FRANKFORT'S articles on the subject in *An. Bibl. I. A.* and in the *Ill. London News.*

The most accurately datable object found at any Indian chalcolithic site is the pottery jar with a Sumero-Babylonian inscription on it discovered by myself at Mohenjo-daro. A detailed examination of this object, with the help of Professor BÖHL of Leyden University, is given in my article referred to in the previous paragraph. Here is a Sumerian text the characters of which can be dated with close approximation. They are practically cuneiform, past the pictographic, non-cuneiform stage, so that the uppermost possible limit is again, as in the case of GADD'S seals, 2800 B.C.; whereas the stage of palæographic development suggests a date nearer to 2500 B.C.—the date arrived at by FRANKFORT and MACKAY independently, and on different grounds. Such an object cannot be found in a layer that is either much older or much younger than the date of the script found on it. The evidence is overwhelming and final. People who obtained this foreign inscribed jar, were contemporaries of the Sumerians of 2800–2500 B.C. This would give, roughly, but reliably, the main culture-period of Mohenjo-daro. Chanhu-daro, on internal evidence, must be brought down a hundred or two hundred years lower. It is likely, as is suggested by MACKAY, that the uppermost layers of that site belong to about 2300–2200 B.C. The lower strata may go back to 2600–2500 B.C., as at Mohenjo-daro. Harappa and Jhukar are, evidently, between the two extreme dates.

The scarlet-ware fragments and pot published by FRANKFORT in *Ill. London News* (see Bibliography at end) again show a trade connexion between the cultures of India and of Mesopotamia. The date in this case may go back as far as the Early Dynastic period, to 3000–2800; though it must be emphasized that there are differences between the Indian and the Mesopotamian finds which would allow a small lapse of time between the two groups of ceramic ware; also, that in both places extremely few pieces of this kind have been found so far. Hence I conclude that they are either importations from a *third* place, or survivals of an *earlier* stratum of which little is known so far. No doubt, further excavations will shed more light on these curious objects, and the day may come when we shall know who were the makers of this scarlet-ware.

The similarities between the Cretan and the Indian bull-grappling games and bull-sacrifice are not only interesting from the point of view of the religion of these people,—again fundamentally different from that of the Vedic Aryans,—but also from the point of view of chronology. Though it is not possible to date these customs with exactitude as is the case with the Sumerian inscription and the seals, yet it is important to note that the Cretan representations showing the greatest similarity to the Indian ones date from about 2200–1800 B.C. Since writing my article, the French Louvre Expedition discovered truly remarkable fresco paintings at Mari, in Syria, dating back to 2000 B.C., and in which there are two representations of bulls being led to sacrifice. This custom, thus, was prevalent in the Near and Middle East between 2000 and 3000 B.C. from the Aegean to the Panjab.

Cumulative evidence thus corroborates more and more clearly the conclusion that the materials *so far unearthed* at Mohenjo-daro, Harappa, Jhukar, Chanhu-daro do not reach back farther than 2800 B.C. at

most; the youngest date of the upper layers at Chanhu-daro carry us down to 2200 B.C.

This, of course, does not mean at all that we have reached either limits of this civilization. There can be no doubt whatsoever that this Indus Civilization is much older than that, and that further excavations will reveal earlier strata. All we talk about at present is *the material at present in hand.* It is well known that the lowermost strata cannot be reached at Mohenjo-daro because of the sub-soil water; that the lowermost strata have not been reached at Jhukar, Chanhu-daro or Harappa; and that among the large number of sites surveyed by Sir Aurel STEIN in Baluchistan and by Mr. N. G. MAJUMDAR in Sindh, some may be considerably earlier than any of the sites so far systematically excavated. This is exactly what one can expect. The culture that we meet at Mohenjo-daro is of such a high order that German scholars justly describe it as a *Spätkultur*; it must have had thousands of years of development before it attained the height we meet in about 2800 B.C. The least we can expect is that it is contemporary with the earlier cultures of Sumer and Egypt and that it will be found to reach back to at least 3400 B.C.; but as far as our present materials allow us to date it, this culture lasted from *c.* 2800 to 2200 B.C.; a conservative date that not even the decipherment of the script can change in a considerable manner. The most important evidence lies buried in the ground, and further excavations will help us to come to much more accurate dates.

LAHORE,
CHRISTMAS 1937.

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22. PARROT, Prof. André, "A Revelation of Mesopotamian Painting about 4000 Years Ago". In *Ill. London News*, Oct. 30th, 1937.

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Animal Ecology of Torrential Streams.*

By Sunder Lal Hora, D.Sc., F.R.S.E., F.N.I.,
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ECOLOGY is that branch of biological science which deals with the responses of organisms to the physical and biological factors in their environment. Such responses are popularly known as "adaptations", and for their proper understanding it is of the paramount importance that the structure and the behaviour of an organism should be correlated with the factors in its habitat. Just as an animal organisation is very diversified and thereby we are enabled to recognise genera and species on the nature of certain morphological characters, similarly an environment is composed of a large number of factors, which show an unlimited range of gradations. Adaptation signifies correlation of an animal organisation with its habitat and so long as the varying gradations in a particular environment are not thoroughly understood, the finer adjustments of the animals to their respective external conditions cannot be grasped. In certain cases, where there are marked differences between the habitats of groups of animals generally belonging to distinct genera, or families or to distantly related species, it is easy to indicate that the characters separating one from another are adaptive; but when closely allied species living in an apparently homogeneous environment are studied then it becomes difficult to realize that the minute differences separating them possess any adaptive significance, for though our knowledge of the classsification of species has made great progress, our knowledge of their habits and habitats is very meagre. The fact should not be overlooked that habitats are as difficult to define as are the species.

I have been working on the fauna of Torrential Streams in India for about seventeen years and I confess that it was only when I undertook the study of the Invertebrate fauna, that I became aware of the gradations in this specialized environment. This knowledge has clearly indicated to me the marvellous correlation that exists between the organisation of a torrential animal and its habitat. A field collector usually sweeps the bed of a shallow stream with his bag-net and transfers his catch to a tube containing some alcohol and labels the entire lot "from a clear, rapid-running stream with rocky bed and little vegetation." This material in the hands of museum workers is misleading and suggests that in a single habitat all kinds of forms are met with so that the obvious conclusion is reached that there are no adaptations for particular habitats. For instance a student of mayfly nymphs would find the shrimp-like larvæ of *Bœtis* and the disc-like larvæ of Heptageniidæ, such as *Iron*, living together in a hill stream, and unless the conditions under which these two forms live are known it would be difficult to speak of either of the two forms as being adaptive.

Just as the study of an "organism as a whole" is of the greatest value, similarly I would strongly advocate that in all ecological work the environment should be studied as a whole. But there are limitations. In classifying animals we rely on certain "characters" which we consider to be of paramount importance; similarly in the classification of habitats we have to rely on certain "factors" in an environment. Just as importance of "characters" varies with different taxonomists, similarly the importance of environmental "factors" varies with different ecologists. Hubault[1] in his treatment of the invertebrate fauna of the torrents has relied on the oxygen contents and the low temperature of the water, and has attached a secondary rôle to the rate of flow of water. In the course of my work I[2,3] have been impressed by the fact that the swiftness of the current and the nature of the substratum are the main factors and the

* Read at the 25th Meeting of the Indian Science Congress in the Section of Zoology at the discussion on "Amimul Ecology in Relation to India," and published with permission of the Director, Zoological Survey of India.

[1] Hubault, E., "Contribution à l'étude des Invertébrés Torrenticoles," *Bull. Biol. France Belgique. Suppl.*, 1927, 9, 388.

[2] Hora, S. L., "Ecology, Bionomics and Evolution of the Torrential Fauna, with special reference to the organs of attachment," *Phil. Trans. Roy. Soc., London*, (B), 1930, 218, 171–282.

[3] Hora, S. L., "Nature of Substratum as an important factor in the ecology of Torrential Fauna," *Proc. Nat. Inst. Sci, India*, 1936, 2, 45–47.

others, though of great value, for the existence of the animals, are themselves in a great measure dependent on the rate of flow of water. To utilise the advantages afforded by the physico-chemical properties of the cool and highly oxygenated waters of brooks, in the first place it is essential that the animals should be able to maintain their hold in swift currents. The following classification has, therefore, been based on the rate of flow of water at different strata and it has been observed that animal organisation shows a definite correlation to this factor in the environment.

A brook consists of a series of rapids, falls and pools, and generally flows over a rocky bed with tufts of mosses and weeds covering rocks and stones here and there. The fauna of the pools is different from that of the rapids and again the animals that live on rocks in a rapid are different from those that live in moss. If there is sand in the bed then we find burrowing animals which are different from the rest. Let us confine our attention to the shallow, rocky part of the stream and here again we must remember that the current at the bottom and sides is much less than that in the centre at a point about three-fifths of the depth from the bottom. We meet with a gradation in the fauna corresponding with the gradation in the flow of the current. Let us select a small portion of the bed in swift current for more thorough investigation. The stones are loosely placed on one another so that interspaces are left between them through which water flows at a considerably slower rate and the current at the bottom among shingles and pebbles is probably negligible. The rock-inhabiting animals of the brooks can thus be divided into 3 strata: (i) those that live on the exposed surfaces of rocks, (ii) those that live in the interspaces and crevices among rocks and stones, and (iii) those that live among shringle at the bottom. Thus according to their positions in the currents the animals are provided with elaborate means of attachment and are correspondingly modified in several ways to offer minimum resistance to the current. The plant-inhabiting animals of the torrents are also of three kinds. Those, like the larvæ of *Tipula*, that live among roots are sheltered from the current and are the least modified for this habitat. Others like the larvæ of *Phalacrocera* and *Nephelopteryx* entangle themselves among plants by means of chitinous processes and lastly the larvæ of *Simulium*, Chironomids, etc., live on plants attached by means of their extremities so that they dangle freely in the current. Though these animals are differently modified for attachment, which is due to the various ways in which they are affected by the current, yet in response to the high percentage of oxygen in the water they have all reduced their gills. The animals of each habitat can be further divided according to the nature of their food. Most members of the torrential fauna feed on algæ and slime covering rocks and stones, but some have evolved highly complicated devices to strain microplanktonic organisms out of the rushing currents and there are few, like the nymphs of *Perla*, which are predaceous.

In broad outline the factors indicated above influence groups of animals and mould them to similar lines. The finer gradations of these very factors distinguish species. Take for example, the three species of *Bœtis* described by Dodds[4] from Colorado living on rocks in swift currents.[5] *B. tricaudatus* with three caudal cerci lives in currents flowing at the rate of 5 feet per second. *B. intermedius*, in which the middle caudal circus is decidedly shorter, lives in waters flowing as much as 8 feet per second and finally *B. bicaudatus*, in which the middle circus is represented by a vestige only lives in places where the water flows at the rate of 10 feet per second. The reduction of the middle circus can thus be correlated with the increased swiftness of the current and such a reduction can be traced among the nymphs of other mayflies also. The reduction of the middle circus is accompanied by the tapering of the body posteriorly so that the stream-like moulding of the body is carried to the extreme posterior end. It is clear then that minute difference between species can be correlated with the intensities of certain factors in the environment.

Let us now consider the different body-forms of brook-inhabitants. They are gracefully stream-lined so that the water glides over them smoothly and no "dead water" area or eddy-formation takes place in the neighbourhood of the animal. The animals that swim or swing in the current, are

[4] Dodds, G. S., "Mayflies from Colorado," *Trans. Amer. Ent. Soc.*, 1923, **49**, 93–114.

[5] Dodds, G. S., and Hisaw, F. L., "Ecological Studies of Aquatic Insects. I. Adaptations of Mayfly Nymphs to Swift Streams," *Ecology*, 1924, **5**, 137–148.

cylindrical so as to present a stream-line to the current on all sides, whereas those that lie flat on the bottom are stream-lined along the exposed surface and flattened along the opposing surface. The animals either become greatly elongated or they assume limpet-like forms. In the case of the aeroplane struts it has been found that both forms are equally effective in reducing resistance. But it may be asked why some animals assume one form and the others a different form. This differentiation in the ultimate form is due to the initial form with which an organism starts its life in rapid waters, for in nature it seems to be a rule that, with whatever initiative an organism may be endowed in the beginning, it is through the continuous moulding of the same material under different sets of conditions that different forms are produced. New structures do not arise *de novo*, the old structures by taking on new functions are so altered, and consequently alter the entire organisation, that sometimes the genetic affinity between the two allied forms can be hardly discerned.

It is sometimes advanced as an argument against adaptations that similar forms are found in different habitats, but the point to be considered in each case is whether it is adjusted to live or not in the place where it is found. Two different looking dragonfly larvæ are found clinging to plants in swift currents. *Macromia ida*, a flat-bodied larva, belongs to the bottom-dwelling Libellulinæ and *Matrona basilaris*, to the weed-dwelling Calopteryginæ. Both forms being useful for reducing resistance are retained without great change, whereas in response to the pulling action of the current the legs have become elongated and are spidery. The spidery legs enable the animal to swing before the current without losing hold of the substratum. Here is an instance showing divergence in form but convergence in the organs of attachment.

In conclusion, it may be stated that for a proper appreciation of organic evolution or adaptation it is of the greatest importance that the characters of an animal and the factors constituting its habitat should be investigated at the same time, for it is difficult to conceive of a living animal apart from its environment. Ecological studies alone will help us to eliminate all chances of confusion arising out of the similarity of structures under apparently different conditions or of the divergence of characters under apparently identical conditions. My studies have shown that sometimes an identical factor is found in operation under different conditions and *vice versa*.

On Structural Variations in the Indian Leech *Hirudinaria granulosa*.*

By M. L. Bhatia, M.Sc.,
Lecturer in Zoology, University of Lucknow.

DURING the course of study on the anatomy of *Hirudinaria granulosa* I have come across some interesting variations. It is considered desirable to record them for the information of those interested in this particular group of animals. The variations have been noticed in the number and arrangement of sensillæ and eyes, the posterior sucker, the structure of the crop (stomach), the absence of some of the testes, and the extension of vasa deferentia in segments where there are no testes and where they serve no function.

I. *Sensillæ* (the segmental receptor-organs).—Typically there are 4 dorsal and 3 ventral pairs of sensillæ on the first annulus of each somite in *Hirudinaria*, but several specimens show different kinds of variations. Moore mentions, "Not infrequently sensillæ are divided into two or three small ones, or may be absent or in a changed position, but such cases are obviously individual variations." All variations in sensillæ that I have noticed come more or less under the description given by Moore.

II. *Eyes.*—The normal number of eyes in this species is five pairs. Moore states, "In Hirudidæ there are almost invariably 5 pairs forming a regular arch on somites II to VI, suggesting the name ten-eyed leeches". These 10 eyes are metamerically disposed in segments 1, 2, 3, 4 and 5; a pair being present in each segment. Moore accepts that eyes are variable in Erpobdellidæ

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* Read before the Indian Science Congress, 1932.

Gratiolet-Whitman's method of segmentation is followed in this paper.

but obviously he did not come across any variations in Hirudidæ in his collection of leeches. It is therefore considered fit to mention these here. "Eyes, both in number and arrangement, are of great diagnostic value." Variations in both these respects were found in *Hirudinaria granulosa*. Individuals with 2 or even 3 less or more eyes than normal were recorded as well as cases in which the arrangement was greatly altered.

It is unwise to express any opinion as to the causes that might have brought about these abnormalities. They are undoubtedly due to some kind of disturbances or to environmental changes in early developmental stages of the individuals. Care was taken to note the locality from which such specimens were procured and the general conditions and usual habitat in such specimens were always found to be normal, or at least of a nature which does not adequately explain the cause of all such disturbances.

A few interesting cases are mentioned :—

A specimen collected from Achha Bal, Kashmir, shows maximum departure from the regular normal order [Fig. 1(*a*)]. The total number of eyes present in this specimen is 7 and they are disposed in the following manner. There are 3 eyes on the first segment, two situated in the normal position and one situated in the groove, between the first and second annuli, which is evidently the eye belonging to the second segment because the intermediate sensilla* of that side is absent. Segment II is devoid of eyes. Segment III has a pair of eyes but both the eyes are displaced and occupy abnormal positions. One of these is placed in the annulus behind its proper place and the other is fused with the right eye of the next segment. The fourth segment again has a pair of eyes ; one eye is free and is placed in the annulus behind its normal one and the other, as already stated, is fused with one of the eyes of the preceding segment. The fifth segment is devoid of eyes.

Another interesting arrangement of eyes is seen in a specimen collected from rice-fields, Mans Bal, Kashmir [Fig. 1(*b*)]. In this the first pair of eyes is situated in the groove between the first and second segments and it is difficult to determine whether it represents

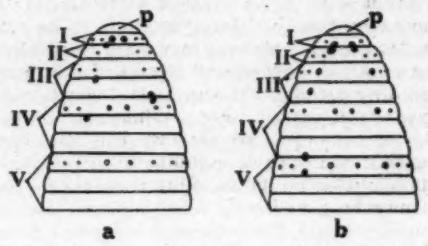


Fig. 1.

the first or second pair of eyes, for the pair that ought to be present on the second somite is absent. Evidently, the two pairs are fused together, inasmuch as the paramedian sensillæ on both these segments are absent, and both the eyes are comparatively bigger in size than the remaining eyes. Third segment has one pair situated at its normal place, and one additional eye on its second annulus. Fourth segment has only one eye (right) laterally placed. Fifth segment has three eyes which are all very much displaced.

In another specimen [Fig. 1(*c*)], collected from rice-fields, Ganderbal, Kashmir, there is more than the normal number of eyes. Unfortunately, the head region of this specimen was damaged, and it is not possible to determine with great certainty the details. Segment I has one additional eye in the centre. Segment II is quite normal, only the right eye is smaller than the left and it may be that the median eye on the second is a part of the former. Segment III, again, has one additional eye over the normal pair situated near the left eye. Shaded portion in the figure indicates the damaged part of the animal. The fifth segment is similar to the 4th. Total number of eyes is 12, *i.e.*, two eyes in excess.

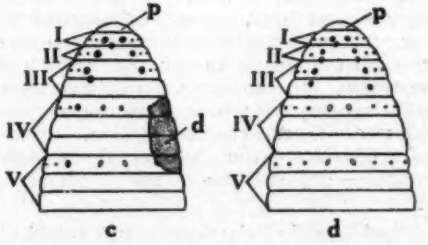


Fig. 1.

* The eyes are glorified sensillæ.

The first pair of eyes of most Hirudidæ belong to the paramedian and the other to the intermediate series (Moore).

From a pond near Itaunja (U.P.) another specimen was collected which has more than the normal number of eyes [Fig. 1(*d*)]. In it the eyes have peculiarly migrated to some of the anterior somites and have become more or less aggregated there. Consequently, the last two somites are devoid of eyes. First segment has 3 eyes, second and third both have additional pairs, fourth and fifth are without any eyes.

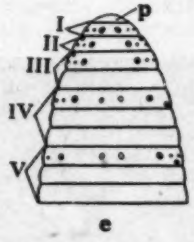


Fig. 1.

Some of the typical cases exhibiting disturbances in number and arrangement of eyes have been mentioned. In any collection one will invariably come across specimens having in addition to the normal number and arrangement small ocular patches which may be seen scattered without any definite arrangement. I have made an attempt to sum up and reproduce all possible cases, of secondary eyes, in one sketch [Fig. 1(*e*)].

III. *Posterior sucker.*—The two suckers (anterior and posterior) are the chief locomotory organs by the attachment of which leech can move about in caterpillar fashion. The posterior sucker is much more symmetrical and, on account of the interwoven arrangement of its muscles, is an effective adhesive organ. Its absence will certainly disable the animal to a great extent, yet some specimens were found devoid of the posterior sucker. The absence of a sucker is no doubt the result of some accident. These specimens were kept alive under observation for some time and were found not lacking in their usual movements. The anterior sucker in such specimens, as a natural consequence, is more strongly developed and compensates very well for the absence of the posterior sucker [Fig. 2 (*a*),(*b*)]. The anal aperture, which in the normal course, is situated on the dorsum at the place of attachment of the posterior sucker

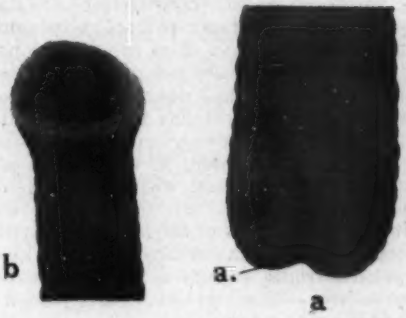


Fig. 2.

(*a*) Dorsal view of the posterior region of *H. granulosa* without posterior sucker. *a.*-anus.

(*b*) Anterior region of the same showing well-developed anterior sucker.

is in this specimen placed at the posterior-most extremity. The stump, although it has no disk to serve the adhesive function, helps to push the body forward.

IV. *Crop* (stomach).—The crop extends from somites IX to XVIII and consists of

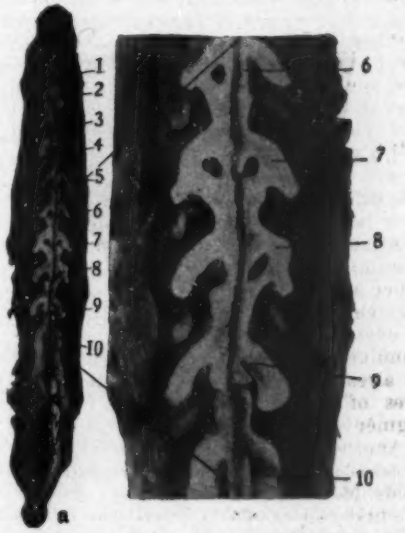


Fig. 3.

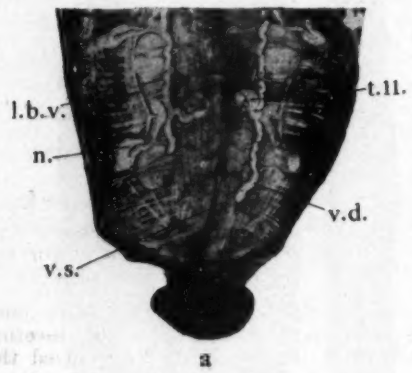
(*a*) Dissection showing the digestive system.—1 to 10 pairs of crop cæca.

(*b*) Portion of 5 cæca—highly magnified, 6, 7, 8, 9 and 10. 6, 7 and 8 showing fusion of cæca with the axial tube.

metameric series of axial chambers separated by inter-segmental constrictions. Each chamber bears a single pair of cæca which begin in segment IX. The pre-genital pairs are usually smaller and irregular. The post-genital cæca are fully developed and reach the next segment. It has been observed in a specimen that the caudal ends of the sixth, seventh and eighth pairs of cæca in the post-genital region are fused with the succeeding axial chamber [Fig. 3 (*a*), (*b*)]. In the sixth pair it is the cæcum of the left side only that is fused with the axial chamber and in the eighth the right cæcum is fused and the left is free. There is the regular lumen at the places of fusion.

V. *Testes.*—Normally there are 11 pairs of testes in *Hirudinaria* which are arranged in pairs from segments XII to XXII inclusive. In the course of dissection I have seen that there are great anatomical variations and it is not rare to find a testis or a pair of testes more or less than the ordinary number.

VI. *Vasa deferentia.*—The vasa deferentia are a pair of longitudinal tubes which run forward (from segments XXII to X) in a sinuous course in the ventral body wall near the vesicles of nephridia. In some of the specimens dissected it was found that posteriorly the vasa deferentia of both sides extend to the next (post-gonadial segments XXIII or even up to XXIV) segments in which there are no testes [Fig. 4(*a*)]. Then in the anterior region, the vasa deferentia, in the normal course, terminate in segment X where they become convoluted to form the epididymes, but in some specimens they have been seen extending forward to segment IX [pro-gonadial segment, Fig. 4(*b*)].



a

Fig. 4 (*a*).

Dissection showing abnormal extension of vasa deferentia to post-gonadial somites.

l.b.v.–lateral blood-vessel; *n.*–nephridium; *tl.*–eleventh testis; *v.d.*–vas deferens; *v.s.*–ventral sinus.

b

Fig. 4 (*b*).

Dissection showing abnormal extension of vas deferens to the progonadial somites.

ep.–epididymis; n_4.–nephridium 4th; *ov.s.*–ovis c; *v.*–vagina; *v.d.*–vas deferens.

I am deeply indebted to Prof. J. P. Moore of the University of Pennsylvania, for his advice and criticism in connection with this paper.

Moore, J. P., (W. A. Harding and J. P. Moore), *The Fauna of British India, including Ceylon and Burma*, Hirudinea, 1927.

Moquin-Tandon, A., *Monographie de la famille des Hirudinees*, 1826, Paris.

Scriban, A., and Autrum, H., *Hirudinea Handbuch Der Zoologie Kukenthal*, 1928–34.

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Dr. J. A. Voelcker, C.I.E.—An Appreciation.

THERE are two much valued volumes in the present writer's book-case, one modestly bound in maroon cloth, the other in heavy green leather, tooled in gold. Both are inscribed by the author, the first dated December 1916, the last May 1926, nearly ten years later. The title and contents of each volume are the same—"Report on the Improvement of Indian Agriculture" by John Augustus Voelcker, Consulting Chemist to the Royal Agricultural Society of England.

The inscription in the second volume bears witness to the author's continued friendship. Ten years' sojourn in India had also enabled the recipient more fully to recognise the value of the work and proposals recorded in the Report.

That this recognition was well justified was evident from the action of His Excellency the present Viceroy, who, after his experience as Chairman of the Royal Commission on Agriculture in 1928, recommended Dr. Voelcker for the distinction of C.I.E. This honour was given to a man personally unknown to Lord Linlithgow, and after the lapse of thirty years from the time when the work was done, simply on account of the remarkable value of the observations recorded and the recommendations made.

There are probably few of the present generation of agricultural workers in India who have a clear conception of the condition of things before Dr. Voelcker's Report and of what they owe to his wise criticism and foresight.

Before his time there was little or no scientific control of any kind over such attempts as were made at agricultural investigation. Few, if any, chemical analyses were available even, *e.g.*, to distinguish between the comparative values for irrigation of canal water and well water. The problem of *usar* or alkali soils was approached quite empirically without any chemical knowledge of the quantity and character of the salts present.

The great agricultural industries of Tea, Coffee, Sugar and Indigo were without scientific guidance. The last named in particular with its complicated problems in biochemistry was often at the mercy of charlatans with patent specifics.

The subsequent action of Government in appointing a special scientific officer was unfortunately too late to save the industry from the competition of the synthetic product.

In the sugar industry even such a universal implement as a centrifuge finds its original recommendation in Dr. Voelcker's Report.

In a letter to the present writer dated 22nd September 1936, acknowledging the Annual Report issued by the Society of Biological Chemists, India, on Biochemical and Allied Research in India, Dr. Voelcker expresses his amazement at the enormous strides which the pursuit of agricultural science has made in a country like India that used to be associated with stereotyped methods and where he confesses he had hardly thought such developments possible. He speaks indeed of the dawn of a new era, such things as colloids, vitamins, etc., being comparatively new acquaintances to the older generation.

Unfortunately, some of the problems to which he drew attention still remain. The manure supply is still deficient and waste of valuable sources of wealth is still too frequent.

Sir John Russell has drawn attention to the continued difficulty in bridging the gap between the research farm and the cultivators' farm.

The load of debt still bears heavily on the countryside.

Still the new era of which Dr. Voelcker speaks is surely here and the present-day workers may well spare a thought for the wise pioneer to whom they owe so much.

Although the present writer only once had the pleasure actually of meeting Dr. Voelcker personally he has enjoyed the privilege of an uninterrupted correspondence with him since his own arrival in Bangalore in 1916. It has often happened that the old gentleman's fairly lengthy communications written in his distinguished, if at times rather difficultly legible script, remained for long unanswered. There is one in the "for disposal" basket to which alas a written reply is no longer possible. It is something to be grateful for to have retained the confidence and friendship of such a

sterling character as Dr. Voelcker over so many years. In no one of his letters was ever a harsh or bitter judgment. He would always find something good to say even of one whose actions he might in some respect criticise. He reminded one of the dear old lady who when the opinion was expressed that she would find something good to say of the devil, exclained, " well at any rate he is very busy ".

Dr. Voelcker was always eager to see justice done to good work. He was glad when the name of Munro was mentioned as the discoverer of the principle of "activation " in connection particularly with intensive nitrification. He remembered Munro as a modest worker who never sought the lime-light and was better at laboratory research than at its technical application.

Of Dr. Harold Mann's loyalty and hard work as his second in command at Woburn he could not speak too highly although he had little real sympathy with his " leftist " politics, describing him in this connection as a " caution ".

He admired the fighting qualities of his friend and contemporary, Professor H. E. Armstrong, but was quite equal to standing up to him in argument if the occasion seemed to require it. He found a bond of agreement with him in a distrust of overmuch theory and a respect for honest craftsmanship. This attitude of mind made him doubtful of the value placed upon some modern developments in agricultural research, particularly the application of statistical methods to small plots. He complained that it was impossible to *show* the farmer the result, *e.g.*, of manurial trials.

Throughout, however, he was, as has been shown, appreciative of all that was good and eagerly maintained his many interests and activities to the end.

Of him it might well be said in the splendid elegiac line of Kipling,

" He did his work and held his peace
And had no fear to die. "

GILBERT J. FOWLER.

Madras,
February 14, 1938.

Metrogon.

A NEW photographic lens, called the Metrogon, which enables a single photograph taken straight down from an airplane to show three times as much area as has previously been possible from the same altitude, is the latest achievement of the BAUSCH & LOMB OPTICAL CO.

The importance of the lens in aerial photography and mapping work cannot be overemphasized. It had previously been necessary to fly higher in order to cover more ground but the haze and other factors introduced by high altitude reduced sharpness and accuracy in aerial mapping. With the new Metrogon fitted to the camera, a plane can photograph three times as much ground without flying any higher or farther than has been necessary with the average lens previously used.

While lenses covering wide angles are not new, the combination of very wide angle with sharpness and freedom from distortion at the relatively high speed of f : 6·3 is regarded as an optical achievement. The Metrogon covers 90° of field and has a focal length of five and a quarter inches.

So clear is the definition it gives that a photograph made from a height of one mile can show separate railroad ties anywhere within a two-mile circle beneath the plane. The fineness of detail which the new lens can record at the center of the picture is limited only by the graininess of plates and films. Distortion, present in all photo lenses, has been almost completely eliminated in the Metrogon. Since such distortion ordinarily becomes pronounced with increasing angle covered by the lens, its correction was the major obstacle to be overcome in the design of the lens.

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Effect of Temperature on the Dissociation of Sulphuric Acid.

The dissociation of sulphuric acid in aqueous solutions was studied with the aid of Raman effect by Nisi,[1] Woodward,[2] Woodward and Horner,[3] and Ramakrishna Rao[4] in detail. Ramakrishna Rao found at increasing dilutions the lines 562, 910, 1171 and 1365 disappearing whereas the intensity of the 1043 line increased correspondingly. Hence he attributed the 1043 line to the HSO_4' ion, as this line is found also in acid sulphates, and the 910 line to the H_2SO_4 molecule. Woodward and Horner attributed 381, 556, 910, 978 and 1121 frequencies to H_2SO_4, 595, 895·5 and 1036 to HSO_4' ion and 452 and 982 to SO_4'' ion, while 417 and 1195 were found to be common.

A study of the Raman lines of sulphuric acid at 30° C. and 200° C. by the author has revealed conspicuous changes in their structure and frequencies. The 416 line is found to consist of two maxima, 413 and 438, at laboratory temperature and a new maximum appears at 468 at the higher temperature, the intensity of the whole band increasing slightly. The 558 line shifts its intensity maximum to 578 at 200° C. and the band width is slightly diminished. The 928 line which is found to have a single sharp maximum at 928 is split up into two maxima 918 and 938 at the higher temperature with a corresponding increase in band width. The 1048 line which is of very low intensity at laboratory temperature increases in intensity at the higher temperature. There is a slight shift in the maximum of this band at the higher temperature towards longer wave-lengths. The 1178 line which is a diffuse band at 30° C., gets more diffuse at the higher temperature and diminishes considerably in intensity.

A comparison of these results with the results of authors who studied dissociation of the acid in aqueous solutions points out to a similarity in the effects of temperature and dilution. In solutions it was found that the 417, 558 and 1048 lines shift towards longer wave-lengths at higher dilutions. The same effects are obtained even by increasing temperature. Moreover the 1048 line which is characteristic of the HSO_4 ion distinctly increases in intensity at the higher temperature as in the case of dilution, whereas the 1178 line decreases in intensity.

The similarity in the effects produced by dilution and by increased temperature on the acid suggest the dissociation of the acid at higher temperatures into H' and HSO_4'

ions. There is a slight evidence of the formation of SO_4'' ions at 200° C. as the 981 line charecteristic of the SO_4'' ion and the maximum at 452 attributed by Woodward and Horner to the same ion are just barely detectable in the microphotometric curves of the Raman spectra of the acid at that temperature.

P. KOTESWARAM.

Andhra University,
Waltair,
March 2, 1938.

[1] *Jap. Jour. Phys.*, 1929, **5**, 119.
[2] *Phys. Zeit.*, 1931, **32**, 212.
[3] *Proc. Roy. Soc.*, (A), 1934, **144**, 129.
[4] *Ind. Jour. Phys.*, 1933, **8**, 123.

Space-Group of the Stable Modification of The Crystals of *m*-Nitrobenzoic Acid.

CRYSTALS of the stable modification of *m*-nitrobenzoic acid belong to the monoclinic prismatic class. They have been examined by the rotation and oscillation method using copper K radiation. The dimensions of the unit cell are: $a = 10{\cdot}41$ Å, $b = 10{\cdot}70$ Å, $c = 13{\cdot}22$ Å, $\beta = 91°12'$. This gives an axial ratio in good agreement with that obtained from crystallographic data (Groth, IV, p. 475).

Oscillation photographs were taken about the *a*, *b* and *c* axes at suitable small angles and a large number of planes identified. Planes (h01) for which h is odd are halved and (010) is also halved. The space-group is thus C_{2h}^5. The number of molecules per unit cell is four showing that the molecules are asymmetric. The *ortho* and the *para* compounds are under investigation.

V. C. THAKAR.

Chemical Laboratories,
Royal Institute of Science,
Bombay,
February 23, 1938.

A Method for the Determination of the Cross-section of Molecules of Soluble Amphipathic Substances.

SOLUTIONS of substances whose molecules have both the hydrophilic and the hydrophobic groups (called "amphipathic" by G. S. Hartley[1]) show activated accumulation as shown by the work of the present author as well as of others.[2,3,4,5,6] The solute molecules accumulated at the surfaces of such solutions, show a reluctance to get back into solution. This fact can be taken advantage of, for measuring the absolute area occupied by the accumulated molecules; the details have been given in a former communication.[3] It can now be shown that the accumulated molecules can be collected by sweeping with a barrier. Such sweepings are found to be more concentrated than the rest of the solution. By measuring the quantity of the sweepings and the change in concentration, the number of molecules which were present at the surface can be calculated. In a typical experiment the cross-section of benzopurpurine 10B works out to be of the order of 30×10^{-16} sq. cm. This method is capable of wide application as it can be adopted in all those cases where activated accumulation is exhibited.

K. S. GURURAJA DOSS.

Department of Chemistry,
Central College,
Bangalore, University of Mysore,
February 2, 1938.

[1] Hartley, *Aqueous Solutions of Paraffin-chain Salts*, 1936, p. 44.
[2] Doss, *Curr. Sci.*, 1937, **4**, 405.
[3] —, *Proc. Ind. Acad. Sci.*, 1936, **4**, 97.
[4] —, *Curr. Sci.*, 1937, **5**, 645.
[5] McBain and Wilson, *J. Amer. Chem. Soc.*, 1936, **58**, 380.
[6] Florence, Myers and Harkins, *Nature*, 1936, **138**, 406.

Investigation on Rice.

THE question of quality in rice—the most important cereal food of India—has been receiving attention from several workers. We began our study of the problem seven years ago and attempted to correlate quality with the physico-chemical properties of rice. Part of this work has been published[1] and a paper dealing with further work will be presented before the Tenth International Congress of Chemistry at Rome. I have already stressed the view[2,3] that rice is to be looked upon as a colloidal system intermediate between the lyogel and the xerogel. Important colloidal changes take place in the rice kernel during the later stages of the maturing of paddy. The lyogel loses water and there is a drift towards the xero state,

which is characterised by rigidity of structure. It is well known that rice from freshly harvested paddy does not cook well and is not properly digested. This is because the drift to the xero state has not advanced sufficiently. Colloid chemists are familiar with the "Wet-heat" treatment[4] of silicic acid lyogels to produce the xero gel of proper quality. The usual "Parboiling" of paddy is to be looked upon as a means of subjecting the cereal to wet-heat. I have studied the colloidal aspect of "Wet-heat" treatment of paddy and the investigations so far carried out seem to indicate that there is an optimum temperature for the heat treatment of paddy. In the method now developed, hot air at a temperature not exceeding 70° C. is used in "Parboiling" and since water is not employed to impart heat, the rice obtained is not unattractive in colour. The need for storage of paddy for three to six months before it can be hulled is also obviated by this "Parboiling".

In common with other workers,[5] I find that swelling of rice is a convenient measure of its quality. The method of measurement of swelling, developed in this laboratory, gives reproducible results. The swelling of rice (when it is cooked) is a complicated phenomenon and the individual rôles of starch, proteins and the capillary-active substances present in rice are now being investigated.

Another line of work that is being conducted in this laboratory is the preservation of rice bran and polishings without detriment to flavour and the B_1 vitamin content. The use in India of "Whole" rice is no doubt being vigorously advocated, but there are certain fairly well-known difficulties associated with the storage and use of unpolished rice. The storage of bran and polishings and their use as human food material are questions of great practical importance.[6] It is of interest that while the bran layers of rice keep well when the cereal is in the unhulled state, the bran obtained on hulling, is difficult to keep in good condition. Whether the husk merely keeps out fat-splitting or oxidative micro-organisms, or whether the alkaloid[7] present is in any way responsible is being studied. Rice bran itself has been found to be an anti-oxidant,[8] and we are trying to reinforce this valuable property so that by inhibiting the development of undesirable odours we can safely store rice bran and polishings and make them available for use as human food.

B. Sanjiva Rao.

Department of Chemistry,
Central College, Mysore University,
Bangalore,
February 14, 1938.

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[1] K. Subbaramiah and B. Sanjiva Rao, *Proc. Ind. Acad. Sci.*, **1937**, **6**, 36–58.

[2] M. R. Aswathanarayana Rao and B. Sanjiva Rao, "Physico-chemical investigations on varietal differences in rice"; B. Sanjiva Rao, "The physico-chemical factors determining quality in rice" [*Symposium on Colloids*, Indian Academy of Sciences, December 1935].

[3] B. Sanjiva Rao, "Physico-chemical investigations on rice," *Proc. Ind. Sci. Cong.*, 1938. *Chemistry Section.*

[4] Holmes, *Laboratory Manual of Colloid Chemistry*, 1934, p. 192.

[5] Borasio, *Griorn risicoltura*, **1935**, **25**, 164; Cited from *Chemical Abstracts*, **1935**, **29**, 7519.

[6] West and Cruz, *Philippine J. Sci.*, **1933**, **52**, 1.

[7] Hofmeister, *Biochem. Z.*, **1920**, **103**, 218.

[8] Peters and Musher, *Ind. and Eng. Chem.*, **1937**, **29**, 146.

Base Metal Thermocouples : Their Characteristics.

Amongst the thermocouples that have been studied extensively,[1] the chief base metal ones are those with iron and copper; but owing to the susceptibility to oxidation at high temperatures, their frequent use is not very reliable. Copper-Constantan and Copper-Copel couples have been used for accurate temperature determinations at moderate temperatures (about 150° C.).[2,3,4] We have studied the thermo-e.m.f. relations of some of the common base metal thermocouples and their characteristics will be published *in extenso* elsewhere.

We have found the use of Nichrome-Constantan couple quite reliable at moderately high temperatures (upto 800° C.). The couple gives almost a straight line thermo-e.m.f. relationship and as wide an e.m.f. as obtainable with Iron-Constantan and Copper-Constantan couples; moreover both the alloys can be satisfactorily used at high temperatures. Some of our observations for the Nichrome-Constantan couple were as below :

Temp.° C.	E. M. F. millivolts.
100	5·1
200	10·8
300	17·2
400	23·7
500	30·6

Thermocouples with Nickel generally (in combination with Nichrome, Iron and Copper) give irregular thermo-e.m.f. curves over the temperature range 250°–400° C. owing to some molecular transformation taking place in Nickel[5]; but we have observed that this irregularity is overcome when Constantan is coupled with it.

We have recorded the neutral points (*i.e.*, the mean difference in temperature of the cold and hot junctions of the couple when the thermo-e.m.f. curve crosses the zero e.m.f. line—*vide* Tech. Data on Fuel, 1928, p. 27) at 205° and 275° C. for Iron-Nichrome and Copper-Iron couples respectively.

M. R. MANDLEKAR.
H. N. BANERJEA.

Department of Chemical Technology,
Bombay,
December 29, 1938.

[1] *Landolt Bornstein Tabellen*, 1923, p. 1029.

[2] Eichelberger, *J. Amer. Chem. Soc.*, 1934, **56**, 799.

[3] Webb and Lindsley, *ibid.*, 1934, **56**, 874.

[4] Quiggle, Tongsberg and Fenske, *Ind. Eng. Chem., Anal. Ed.*, 1934, **6**, 466.

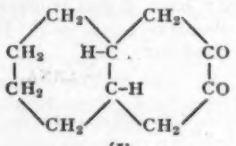
[5] *Dictionary of Applied Physics*, 1922, **1**, 901.

2 : 3-Diketo*trans*decalin.

ON treating the dibromo compound from (*cis*)-β-decalone with aqueous potash, Wallach and Wissenborn[1] obtained (*cis*)-2 : 3-diketodecalin (m.p. 88–89°), along with a small quantity of a diketonic compound (m.p. 99–100°) not investigated. Recently, Rao and Kuppusamy[2] obtained by oxidising *trans*-β-decalone with selenium dioxide in boiling xylene (24 hours) two fractions: (i) b.p. 106–08°/6 mm. (yield, about 25%), and (ii) b.p. 126–30°/6 mm. (yield, about 35%), of which the former was considered by them to be the diketone (2 : 3 or 1 : 2) of *trans*decalin and latter was not investigated. The diketone prepared in connection with some other work is now found to be different from that of Rao and Kuppusamy.

Trans-β-decalone was readily oxidised by selenium dioxide in boiling ethyl alcohol (3 hours) to yield a crystalline product, m.p. 99–100° (yield, 60–65%) along with a small quantity of a liquid, b.p. 96–130/5 mm. (5–10%), which on fractionation yielded some decalone and the solid. The compound, m.p. 99–100° (dioxime, m.p. 229°, yielding a characteristic red nickel salt; disemicarbazone, m.p. 264–65°; quinoxalin derivative, m.p. 177–78°), has now been shown to be *trans*-2 : 3-diketodecalin (I), exhibiting properties of the diosphenol form (II), (i) by oxidation with hydrogen peroxide in quantitative yield to *transcyclo*hexane-1 : 2-diacetic acid, (ii) by reduction with sodium amalgam to 2 : 3-dioxy*trans*decalin, m.p. 141°[3] and (iii) by converting to *trans*hexahydrohydrindenol-carboxylic acid (III), m.p. 134°[4] by boiling with N-sodium hydroxide.

The product m.p. 99–100°, of Wallach and Wissenborn (*loc. cit.*) is evidently 2 : 3-diketo*trans*decalin, probably formed by the contamination of their *cis*-β-decalone with a little of the *trans*-form; the isomerisation of the diketone (m.p. 88–89°) from the *cis*- to the *trans*-form (I) is not probable since the keto groups in the com-



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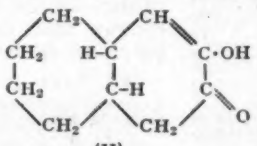

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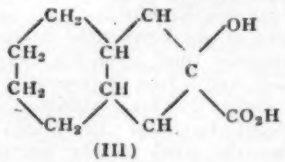
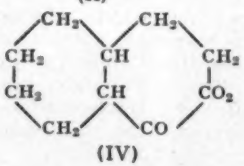


(III)



(IV)

pound are in the β-position and their experimental conditions are not favourable to such an isomerisation.

During halogenation and condensation reactions only the carbon atom in position 3 of *trans*-β-decalone is found to be reactive.[5] *Trans*-β-decalone yields on oxidation with nitric acid *cyclo*hexane-1 : 2-diacetic acid along with a small quantity of the 1-carboxy-2-propionic acid, indicating that the carbon atom in position 1 is also affected. Hence, a careful search is being made for the 1 : 2-diketodecalin (IV) in the products of oxidation of *trans*-β-decalone with selenium dioxide.

Full details will be published elsewhere.

K. GANAPATHI.

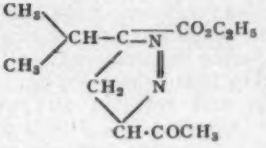
Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
February 5, 1938.

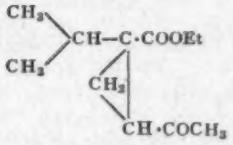
[1] *Annalen*, 1924, **437**, 163.
[2] *J. Annamalai Univ.*, 1937, **7**, 23.
[3] Lehmann and Kratschell, *Ber.*, 1934, **67**, 1867.
[4] — —, *ibid.*, 1935, **68**, 360.
[5] Fen, Mc Quillon and Robinson, *J.C.S.*, 1937, 53; *cf.* Cook and Lawrence, *J.C.S.*, 1937, 877.

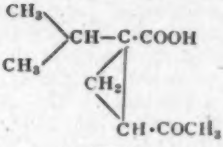
Synthesis of Umbellulonic Acid.

UMBELLULONIC acid (III) is a direct oxidation product of the naturally occurring bicyclic ketone umbellulone. It has now been synthesised as follows:

Ethyl *iso*propyl acrylate has been condensed with diazoacetone to yield a pyrazoline compound, b.p. 130–35°/3 mm. (Found: N, 11·68 per cent.; calc., 12·39 per cent.) The pyrazoline compound (I) splits off nitrogen at 180° and the resulting nitrogen-free ester (II) distils at 135–45°/25 mm. 233–35°/685 mm.; (Found: C, 66·95 per cent.; H, 9·23 per cent.; calc.: C, 66·67; H, 9·09 per cent.) and has yielded umbellulonic acid (III) on hydrolysis. The acid b.p. 190–92°/50 mm. (the b.p. agreeing with that of umbellulonic acid obtained from unbellulone by oxidation), however, does not crystallise, but forms an oxime, m.p. 145–46° (Found: N, 7·64 per cent.; equiv., 182) and a semicarbazone, m.p. 170° (Found: N, 18·30 per cent.; equiv., 228·6.) The combustion values and the equivalents of the oxime and the semicarbazone are in agreement with those of the corresponding derivatives of umbellulonic acid. It is rather peculiar that to the oxime of umbellulonic acid Tutin[1] has attributed the m.p. 169–70°.


(I)


(II)


(III)

The *cis*-configuration of umbellulonic acid now synthesised has been proved by oxidising it to *cis*-umbellularic acid monohydrate, m.p. 95°, and the anhydrous acid, m. p. 124–25°. The mixed melting points of the monohydrate and the anhydrous acid, when taken with the corresponding samples synthesised in this laboratory,[2] remained undepressed.

The resolution of the synthetic variety of the umbellulonic acid could not be effected by its brucine salt on account of the latter not coming in crystalline form due perhaps to the presence of the keto-group.[3]

P. C. GUHA.
M. S. MUTHANNA.

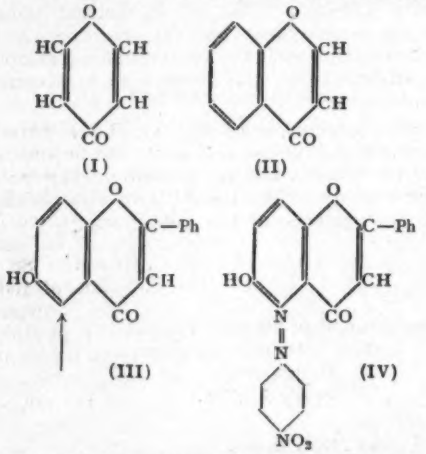
Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
February 8, 1938.

[1] *J.C.S.*, 1904, **83**, 645.
[2] Ranganathan, *J. Ind. Chem. Soc.*, 1936, **13**, 419.
[3] *Cf.* Owen and Simonsen, *J.C.S.*, 1933, 1223.

The Coupling of 6-Hydroxyflavone with Diazo Salts.

THE reactivity of natural colouring matters derived from resorcinol and phloroglucinol towards diazo salts has been the subject of several investigations by Perkin,[1] and Ramachandran and one of us[2] have recently utilised the coupling of catechin with diazo salts for altering the shades of cutch dyeings. While Perkin found that chrysin, apigenin, euxanthone and catechin all gave diazo dyes, the coupling of 6-hydroxyflavone[3] has yielded a mono-azo derivative. *p*-Nitraniline (2 g.) was diazotised with sodium nitrite (1·2 g.) and 50 per cent. hydrochloric acid (9 c.c.) and the solution made up to 50 c.c. To the sparingly soluble sodium salt prepared from 6-hydroxyflavone (0·5 g.) and 1 per cent. caustic soda solution (10 c.c.), sodium acetate (4 g.) in water (10 c.c.) was added, followed by the diazo solution (7·5 c.c.) the temperature of the reactants being maintained at 0°. On leaving overnight in the ice chest, the dye was collected and twice crystallised from glacial acetic acid. The deep orange prisms (0·2 g.) melted at 256°. (Found: N, 10·9; $C_{21}H_{13}O_5N_3$ requires N, 10·9 per cent.)

Fusion with the γ-pyrone ring (I) must be presumed to stabilise one of the Kekule forms of the benzene ring in chromone, the double bonds being fixed as in (II). This is confirmed



by Baker's observation[4] that the Fries reaction on 7-acetoxy-3-acetyl-2-methylchromone leads exclusively to the 8-acetyl compound.

Mills and Nixon[5] regarded the coupling of phenols with diazo salts as evidence of double linkage between the carbon atoms, to which the hydroxyl and the azo group were attached, the hydroxyl activating only the doubly linked carbon atom. Ability to couple with diazo salts has also been used by Fieser and Lothrop[6] to examine the permanent fixation of links in the aromatic nucleus. Conversely it would appear therefore that 6-hydroxyflavone (III) can couple only in position 5 as shown, the *p*-nitrobenzeneazo derivative having the structure (IV). A route to the synthesis of primetin (5 : 6-dihydroxyflavone) thus becomes possible.

Several attempts to synthesise primetin have been recorded. Sugasawa[7] found that the debenzylation of 2 : 3-dimethoxy-6-benzyloxyacetophenone did not proceed normally; the action of benzoic anhydride and sodium benzoate on the oily product, assumed to contain 2 : 3-dimethoxy-6-hydroxyacetophenone, gave an impure 5-hydroxy-8-methoxyflavone. By the action of potassium acetate on 2 : 4-diacetylresorcinol dibenzoate Baker[8] obtained a poor yield of 5-hydroxy-6-acetylflavone, which also resulted from a Fries reaction on 5-acetoxyflavone; but the Dakin oxidation of 5-hydroxy-6-acetylflavone did not yield primetin. Baker[8] also noticed that 6-acetoxyflavone did not undergo the Fries change, the action of aluminium chloride merely leading to the removal of the acetyl group.

H. S. MAHAL.
K. VENKATARAMAN.

Department of Chemical Technology,
University of Bombay,
Bombay,
February 18, 1938.

[1] Perkin, *J. Chem. Soc.*, 1895, **67**, 933; 1896, **69**, 1439; 1897, **71**, 186; 1898, **73**, 666.

[2] Ramachandran and Venkataraman, *Indian Patent Application*, No. 24056 of 1937.

[3] Chadha and Venkataraman, *J. Chem. Soc.*, 1933, 1075.

[4] Baker, *ibid.*, 1934, 73; see also Wittig, Baugert and Richter, *Ann.*, 1925, **446**, 184.

[5] Mills and Nixon, *J. Chem. Soc.*, 1930, 2510.

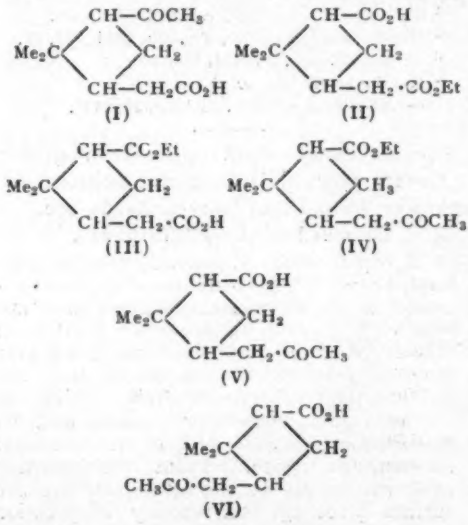
[6] Fieser and Lothrop, *J. Amer. Chem. Soc.*, 1936, **58**, 2050.

[7] Sugasawa, *J. Pharm. Soc., Japan*, 1934, **54**, 295.

[8] Baker, *J. Chem. Soc.*, 1934, 1953.

Trans-1-acetonyl-2: 2-dimethylcyclobutane-3-carboxylic Acid: An Isomer of Pinonic Acid.

In an attempt to synthesise pinic acid monoester (II) by (i) partial esterification of pinic acid, and (ii) partial hydrolysis of diethyl pinate, with an object to convert the acid-chloride of (II) by Blaise reaction into pinonic acid (I), the isomeric acid ester (III) has been obtained in very good yield by the latter method. The mono-acid ester (III, b.p. 158–60°/5 mm.; d_{30}^{30}, 1·0693; n_D^{30}, 1·4532) readily gives the acid-chloride (b.p., 118°/4·5 mm.) with thionyl chloride, which in its turn with zinc methyl iodide yields the ketonic ester (IV, b.p. 118–119°/5 mm.; semicarbazone, m.p. 134°). The ketonic ester on hydrolysis, furnishes the corresponding acid (V, semicarbazone, m.p. 186°). The difference of this acid from both the *trans* and *cis* varieties of pinonic acid (I) obtained from pinene, has been established by comparing the melting points of the semicarbazones and the acid (III) should, therefore, have the constitution assigned to it. Hence, it was expected that the structure of the ketonic acid should be identical with that of orthodonic acid (V) obtained by Fujita[1] by the oxidation of orthodene from orthodon lanceolatum. In view of the difference between the melting points of the semicarbazone of our acid (m.p. 186°) and that of orthodonic acid (m.p. 116–18°), it seems that orthodonic acid may have the *cis*-configuration while our acid (VI) being derived from *trans*-pinic acid[2] represents the *trans* variety.



P. C. Guha.
P. L. N. Rao.

Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
February 9, 1938.

[1] *J. Chem. Soc., Japan*, 1933, **54**, 1811.
[2] *Ber.*, 1937, **70**, 1505.

Redox Systems in the Latex of *Carica papaya*.

The latex obtained from *Carica papaya* contains a remarkably large amount of sulfhydryl compounds, in fact, about ten to twenty times the concentration in any plant or animal source till now known.[1] A fraction of these –SH compounds occurs as glutathione which serves as a natural activator of papain. The search for an enzymic system specific for the reduction of glutathione and SS-compounds to the –SH form, has been actively pursued and a definite lead in this direction has already been given by the work of Hopkins and co-workers. In view of the circumstance that SH-compounds occur in very high concentrations in the latex of *Carica papaya*, it is of interest to enquire whether similar reducing systems are present in it.

Hopkins and Elliot[2] have established the presence of heat labile SS reducing systems in animal tissues. They showed that molecular oxygen oxidises the –SH compounds present in liver to the SS form and the enzymic systems in this tissue reduce the SS-form back to the SH. In the latex of *Carica papaya* freshly obtained, there are similar SH⇌SS redox systems. Here again the SH is readily oxidised to the SS by molecular oxygen. The presence of reducing systems is shown by the circumstance, that when the latex, dispersed in phosphate buffer (pH 7·4) is aerated, the concentration of SH does not fall during the earlier part of the process, but remains constant (or sometimes even slightly increases). The curves shown in Fig. 1 are typical of several experiments. It will be seen that in the earlier part of aeration the reduction processes equalise (and sometimes even out-

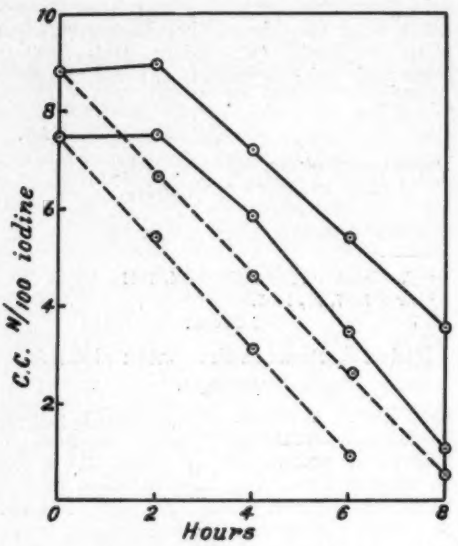


Fig. 1.

Changes in the Concentration of –SH during continuous aeration of the latex (1 gm. in 20 c.c. Buffer Hn 7·4) from *Carica papaya* at 25°·0 C.

Continuous lines .. Normal curves

Broken lines .. Latex previously heated.

(The two sets of curves represent two different specimens of the latex.)

balance) oxidation. When the latex is heated, however, the latent period during which the SH concentration remains constant, is not found and the SH constant, as determined by the method of Kunhau,[3] falls even from the commencement of the aeration, thus indicating the enzymic nature of the systems involved.

When SS-compounds prepared from the latex by oxidising the SH with iodine or hydrogen peroxide, are added to the latex and incubated, there is a distinct increase in the titrable SH content. This reduction is more prominent when the pulp of *Carica papaya* is employed. But in either case, this reducing property is very much reduced when heated prior to incubation.

The presence of such redox system in the latex of *Carica papaya* is very significant. It is believed that papain activity is due to the –SH form of the protein, the enzyme losing its activity when the SH is oxidised to the SS-compound. The reducing systems present in the latex afford a fine mechanism for regulating the proteolytic activity of natural papain, the active form being obtained either directly by the reducing systems or indirectly, through the sulfhydryls which are first formed. Further, the presence of glutathione in the latex calls for a closer study of the reducing systems so as to give a deeper insight into the mechanism of respiration of the living cell which is controlled by the glutathione present in it. The results obtained with plant materials on the one hand and animal tissues on the other,[4] indicate a close parallelism in the enzymic processes involved.

In the light of the recent researches of Hopkins and Morgan[5] on the relation between ascrobic acid and glutathione, experiments involving the estimation of the SH content as well as the vitamin simultaneously in the latex during aeration have been carried out. The presence of ascorbic acid does not in any way affect the course of the oxidation of SH-compounds. The results confirm the main conclusion of Hopkins and Morgan, *viz.*, that the ascorbic acid is protected from oxidation by the sulfhydryl compounds which coexist with the vitamin.

C. V. Ganapathy.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
March 5, 1938.

[1] Ganapathy and Sastri, *Curr. Sci.*, **1938, 6,** 330.
[2] Hopkins and Elliot, *Proc. Roy. Soc.*, **1931, 119,** 58.
[3] Kunhau, *Biochem. Z.*, **1931, 230,** 360.
[4] Hopkins and Elliot, *Loc. cit.*
[5] — and Morgan, *Biochem. J.*, **1936, 30,** 1446.

The Exchange of Moisture between Air Layers near the Ground and Substances like Soils, Plant Leaves, Seeds, etc., Exposed to the Atmosphere.

In a recent series of papers Ramdas and Katti [1, 2, 3, 4, 5, 6] have discussed the phenomenon of the diurnal exchange of moisture between a dry soil surface when it contains only hygroscopic water and the air layers near the ground. It was shown that the soil has its *maximum* moisture content at the minimum temperature epoch and its *minimum* moisture content at the maximum temperature epoch. From the morning after sunrise up to the afternoon, the soil surface gives up moisture by evaporation

to the air layers above but thereafter until the next morning it desiccates the air layers by re-absorbing all this moisture. It was also shown that this phenomenon is most conspicuous in the case of the black cotton soils of the Deccan and least so in the case of the alluvial soil of the Indo-Gangetic plains.

During the current dry season similar experiments were made with dry leaves of jowar and samples of wheat, paddy, bajri and jowar seeds. A sample of black cotton soil was also used for the sake of comparison. The specimens were exposed to the atmosphere in vessels embedded in the soil and their weights determined at 8 a.m. and 4 p.m. daily. The mean weights of the specimens during the period 23rd to 28th November 1937 are given in Table I along with the mean values of the atmospheric humidity at 8 a.m. and 4 p.m.

At the bottom of Table I difference beween the weights of the specimens at 8 a.m. and 4 p.m. are also given. These differences represent the weights of moisture evaporated from the specimens during the day. The values in the case of the different grains are of the same order of magnitude but only about half of the value obtained in the case of the black cotton soil.

In Table II similar measurements obtained when the same specimes were exposed inside a Stevenson screen at ground-level are given. The values are the means for the period of 17th to 22nd January 1938.

The values of the differences at 8 a.m. and 4 p.m. are reduced by the change of exposure but the relative variations are similar.

On selected days the variation in weights of the different specimens was also studied by taking two-hourly observations. These show that while the soil specimen reaches its lowest weight at the same time as the maximum temperature epoch (2 p.m.), the grains and jowar leaf attain their minimum weights a few hours later. The epochs of maximum weight, however, coincide with the minimum temperature epoch.

TABLE I.

	Weight (in grammes) of specimens of						Humidity per cent.
	Black cotton soil	Wheat (grains)	Paddy (grains)	Bajri (grains)	Jowar (grains)	Jowar (leaves)	
8 a.m.	24·675	24·033	15·697	24·598	22·103	0·746	79
4 p.m.	23·623	23·585	15·280	24·079	21·575	0·622	33
8 a.m. value *minus* 4 p.m. value ..	1·052	0·448	0·417	0·519	0·528	0·124	46

TABLE II.

	Weight (in grammes) of the specimens of						Humidity per cent.
	Black cotton soil	Wheat (grains)	Paddy (grains)	Bajri (grains)	Jowar (grains)	Jowar (leaves)	
8 a.m.	24·612	23·879	15·559	23·626	21·806	0·667	50
4 p.m.	23·906	23·670	15·339	23·379	21·567	0·633	20
8 a.m. value *minus* 4 p.m. value ..	0·706	0·209	0·220	0·247	0·239	0·034	30

The results summarised above show that dry plant materials exchange moisture with the air layers surrounding them just as the soils do.

L. A. RAMDAS.
A. K. MALLIK.

Meteorological Office,
Poona,
February 6, 1938.

[1] Ramdas, L. A., *Curr. Sci.*, 1934.

[2] — and Katti, M. S., *Ind. Jour. Agric. Sci.*, 1934 (1), **4**, 923.

[3] — —, *Curr. Sci.*, 1934, **3**, 24.

[4] — —, *ibid.*, 1935, **3**, 612–13.

[5] Katti, M. S., *ibid.*, 1935, **4**, 419.

[6] Ramdas, L. A., and Katti, M. S., *Ind. Jour. Agric. Sci.*, 1936, **6**, 1163.

Indian *Tephrosia* sp. as a Source of Rotenone.

IT is a matter of satisfaction to put on record, the occurrence of rotenone in *Tephrosia candida* DC.; and following the usual method of extraction we have been able to isolate 0·35 per cent. from root bark and 0·5 per cent. from the seeds. The leaves also contain rotenone or allied bodies and give the usual colour reaction,[1] though we have not been able to isolate rotenone in pure state. The root bark extract of *Tephrosia purpurea* also has given the rotenone colour reaction but the amount of rotenone per cent. is perhaps much less than 0·3 and hence our inability to isolate it.

Some of the foreign species, *Caracca* (*Tephrosia*) *Virginiana*[2] of U. S. America and the East African *T. macropoda*[3] have been reported to contain rotenone and have been declared as insecticide. Indian *Tephrosia* occur in great abundance, as a common weed in some of our forests and the fact that such plants of uncertain age contain 0·3–0·5 per cent. rotenone is a matter of considerable importance and economic value.

Rotenone in the seeds is extracted along with the fatty oil with sulphuric ether and from the ether-free residue rotenone resins are precipitated by repeated washings with cold petroleum ether. The rotenone resins are then worked up in the usual manner. It appears that rotenone is concentrated in the root bark and seeds and is practically absent in the stem or debarked root which explains our failure to isolate it on previous occasion.[4]

S. KRISHNA.
T. P. GHOSE.

Forest Research Institute,
Dehra Dun,
March 3, 1938.

[1] Rogers and Calamari, *Ind. Eng. Chem. Anal. Edition*, 1936, **8**, 135.

[2] *Scientific American*, 1933, p. 231.

[3] *Nature*, 1936, vol. 1075.

[4] *Forest Research in India*, 1934–35, Part I.

A White Flowered Type of *Arachis hypogaea* Lin.

IN 1934 a single plant, bearing flowers almost white in colour, appeared in the control line in an experimental culture of the local groundnut variety the seed of which was obtained from the market. The plant was a weakling due to attack by cut worms With great care and by enclosing the plant in a muslin cage a few self-fertilized pods were obtained. In 1935 sixteen plants were raised from the selfed seeds. Out of these 14 had white flowers like their parent's and two bore orange-yellow flowers characteristic of the local variety. All the sixteen plants were selfed by enclosing the entire plant in muslin cages. In the following year (1936) the progeny were grown in plant to row cultures and it was observed that they behaved true to their parental character for flower colour. The white flowered plants giving rise to white flowered progeny and the yellow flowered plants to yellow flowered progeny (Figs. 1 and 2).

Fig. 1.

Branches with Flowers, left: white flowered type, right: orange-yellow flowered local variety.

Fig. 2.

Individual flowers enlarged showing the white colour of the new type in contrast to orange-yellow of the local variety.

A specimen of the local variety of the groundnut from which the white flowered type arose has been identified by Dr. J. S. Patel, as belonging to Loureiro's *Arachis asiatica*, a synonym of *Arachis hypogæa* Lin. The white flowered type resembles the parent material from which it arose in all the plant characters except the flower colour. The following table gives the petal colours based on Ridgway's colour standard :—

Petals	White flowered plant	Local variety
Standard	Marguerite yellow	Ochraceous orange
Wing	Naphthalene yellow	Primuline yellow

The white flowered type which has been bred for three generations continues to breed true for the white colour of its flower.

It is difficult to explain at present why the two orange flowered progenies appeared from the white flowered plant or why all the progenies of that plant, white and orange, continue to breed true for their respective flower colour without any of them segregating for that character. In order to explain the possible origin of the white flowered type, crosses between the true breeding white and orange flowered progenies have been made during 1936 and are at present under investigation.

L. S. S. Kumar.
W. V. Joshi.

Agricultural College,
Poona,
January 22, 1938.

Tadpoles of a Genus not Recorded from India.

In 1918 the late Dr. N. Annandale described certain tadpoles obtained from the Cochin forests, which were provisionally referred by him to the family *Cystignathidæ*. The pectoral girdle of a nearly adult tadpole was dissected and its resemblance to that of *Leptodactylus* was used for identifying the tadpoles with this genus. It was also pointed out that they resemble closely the tadpoles of *Heleophryne natalensis* which had been described by J. Hewitt in 1913. During the last few years, the same tadpoles were collected in the forests of the Anamalai Hills by my colleagues, and I have had an opportunity of re-examining the collection of the Cochin tadpoles through the courtesy of Dr. Baini Prashad. We have in our collection a young frog which has nearly completed its metamorphosis, though an exceedingly small stump of tail and larval mouth are still retained. L. S. Ramaswami has studied the cranial osteology of these tadpoles, and has dissected the pectoral girdle of the young frog. I am appending below a figure of this pectoral girdle and for purposes of comparison, figures of the pectoral girdles of *Hemisus* and *Breviceps* of the family *Engystomatidæ* are also reproduced from Gadow.

After re-examination of my material and comparison with the collection in the Indian Museum, I am certain that these tadpoles do not belong to the family *Cystignathidæ*. The members of the latter group possess an arciferous type of pectoral girdle and *Leptodactylus* has a metasternum with a bony style. Fig. 1 is undoubtedly an example of fismisternia. Both omosternum and metasternum are wanting. The sacral diapophyses are cylindrical and not dilated into wing-like expansions. The position of these tadpoles is obviously among the firmisternia, and they are referable to the family *Ranidæ* on the basis of diapophyses. This view is further supported by the osteological characters of the cranium of the tadpole which, according to Ramaswami, resemble those of *Rana hexadactyla, R. tigrina and R. fusca*. There are, however, a few features peculiar to the Anamalai tadpoles, such as the union of the infrarostral with Meckel's cartilage, the presence of a groove for the passage of a branch of the hyomandibular VII ventrally to the quadrato-cranial commissure and the absence of a pseudopterygoid process.

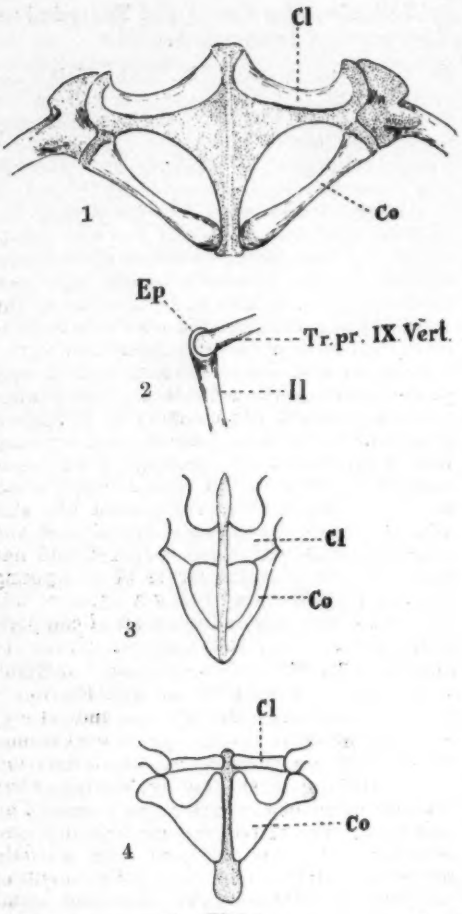


Fig. 1

1. Pectoral girdle of the young frog from Anamalai Hills, supposed to belong to the family *Cystignathidæ*.
2. Sacral diapophysis of the same.
3 & 4. Pectoral girdle of *Hemisus* and *Breviceps* respectively from Gadow.

It will be observed that in respect of the first and the last feature, the Anamalai forms approximate the *Microhylid* example *Uperodon*. Ramaswami supports this view as a result of his examination of the entire cranial osteology of these tadpoles and I am indebted to him for numerous acts of kindnees.

The pectoral girdle of the Anamalai forms differs from *Hemisus* in the absence of omosternum, and from that of *Breviceps* in the absence of xiphisternum. It differs from the pectoral girdle of the *Ranid* group in the absence of both these elements. If the sacral diapophyses can be used as a safe diagnostic character, then this feature together with the firmisternal nature of the pectoral girdle would assign the tadpoles to the *Ranid* family, and the absence of both the sternal elements perhaps might necessitate the creation of a new genus or even a sub-family for their reception. But this must await the detailed examination of the adult forms.

C. R. NARAYAN RAO.

Bangalore,
March 1, 1938.

[1] Annandale and Narayan Rao, *Proc. As. Soc. Bengal. (U.S.)*
[2] J. Hewitt, *Ann. Natal Mus.*, **2**, p. 478.
[3] H. Gadow, *Cam. Nat. Hist. Amphibia and Reptiles*, 1923, p. 25.
[4] J. H. Power, *Transt Roy. Soc. S. Africa*, **13**, Pt. 2.
[5] L. S. Ramaswami, *Proc. Ind. Acad. Sci.*, **2**, No. 1.
[6] M. A. Smith, *Rec. Ind. Mus.*, **26**, Pt. II.
[7] —, *Jour. Nat. Hist. Soc. Siam*, **2**, No. 4.
[8] C. G. S. De Villiers, *Ann. Trans. Mus.*, **13**, Pt. III.
[9] —, *Ann. Uni. Stellen*, **12**, Sec. A, No. 2.

Lucilia sericata Meigen, in Baluchistan.

Lucilia sericata Meigen (Family Calliphoridæ, order Diptera), a notorious sheep maggot fly, is a species of great economic importance. Its larvæ cause cutaneous myiasis in sheep skin and are a serious pest in Europe and Australia. From the Indian region, Patton[1] has so far recorded only two specimens of this fly, which were bred from larvæ from a case of human cutaneous myiasis at Parachinar, Kurram Valley, North-West Frontier Province. So far this fly has never been recorded from Baluchistan.

In our collection at the Fruit Experiment Station, Quetta, some specimens of this fly are present. These were collected by the writer in 1933 from a three days' old carcass of a sheep found near Gailbreth Spinny (Quetta 5,500 ft.). The identification of the species has been done by the Imperial Institute of Entomology, British Museum, London. Attempts are being made to collect data on the biology of this fly in Baluchistan.

NAZEER AHMAD JANJUA.

Department of Agriculture,
Baluchistan, Quetta,
March 1, 1938.

[1] *Bull. Ent. Res.*, 1922, **23**, 113.

Chromosomes in *Camellia thea* (The Tea Plant).

THIS short note deals with the chromosome numbers in four different *jats* of tea growing in the Experiment Station plots. Previous references on the subject of chromosome numbers are available for some Chinese *jats* (varieties)—known generally as *Thea sinensis* or *Camellia sinensis*. The diploid number in these as determined by (Cohen Stuart) Zaldastanishvili,[1] and Ono[2] is thirty (2 X = 30) and the haploid number according to Zaldastanishvili[1] and Karasawa[3] is fifteen (X = 15).

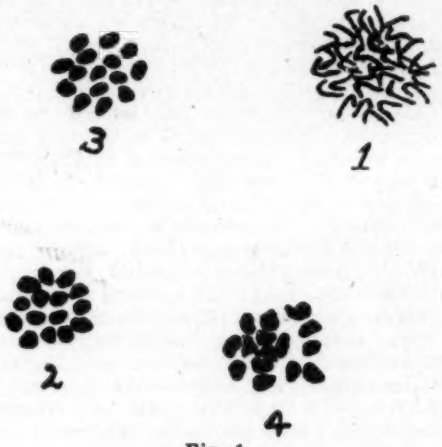


Fig. 1.
Chromosomes in *Camellia thea*.

1. Somatic Chromosomes in a South Indian Variety, 2, 3 & 4. Reduced number in P.M.C.'s varieties "Bonaccard" "*Chapleton*" and "*China*" ? respectively.

Chromosome numbers counted in the four *jats* in South India have confirmed the numbers recorded by the earlier workers.

Variety — *Jat.*	2 X R.T.	X P.M.C.
1. South Indian Seed (A) ..	30	..
2. Bonaccord ..	..	15
3. Chapleton ..	..	15
4. China (?) ..	..	15

A paper in greater detail dealing with mitosis and meiosis in one of the varieties (Chapleton) is under preparation.

M. K. SUBBA RAO.
U.P.A.S.I. Tea Experiment Station, Devershola,
February 11, 1938.

[1] *Plant Breeding Abs.*, 1932-33, 3, 134.
[2] *Ibid.*, 1932-33, 3, 134.
[3] *Ibid.*, 1932-33, 3, 68.

Sulaiman's Predictions.

RECENTLY two adverse references and one criticism of my theory have been published in the columns of the *Current Science*.

I. In the September Number, Sir C. V. Raman referred to "numerous reports and publications emanating from Allahabad regarding the alleged demolition of Einstein's theory of relativity" and relied on Dyson and Woolley's "solar eclipses" for the view that "Einstein's prediction from his general theory of relativity is verified by observations". R. N. Rai[1] has already pointed out that the book had been published before Royds' results of the 1936 eclipse observations were announced.

I submit that the remark of Dyson and Woolley, which was confined only to the relative values of the deflection of light according to Newton's Law and Einstein's theory, has been slightly misunderstood. Even as regards the 1919 observations, which were responsible for the reputation of the General Theory of Relativity, what the authors have actually said is—"The value of 1·98″ as given indicates that the deflection is 1·75″ *at least and possibly somewhat larger*" (p. 47). Commenting on the observations of Campbell and Trumpler (1922), which are supposed to confirm relativity exactly, they remark: "There can be no doubt that the observations show a deflection as great as and *possibly rather more than Einstein's predicted value*" (p. 48). Later after, discussing Freundlich's observations, they express their final opinion in the following terms:—

"*The conclusion is that the displacement is at least as great as* 1·75″, *and possibly a little greater but not more than* 2·0″" (p. 50). Thus a marked excess over Einstein's value has been conceded, which cannot mean verification. I may also quote Evershed's opinion relied upon by the Editor of the *Current Science* in the December Number, p. 304, "These predictions (*i.e.*, Sulaiman's)

might be thought to be confirmed by my measures of Iron lines in the red and by Freundlich's observed value of the deflection of stars near the edge of the Sun ". According to my theory there should be an excess of at least 33%.

Prejudices in favour of an accepted theory died hard and it is no wonder that in spite of successive observations at the last few eclipses showing an undoubtedly excess over Einstein's value, the question should still remain controversial. Although the 1936 eclipse did not offer a favourable opportunity, nevertheless the results are still awaited. A really good opportunity will be furnished at the total solar eclipse of October 1, 1940 in South Africa, Brazil and Columbia, which will be the final test.

I maintain that observations so far made have been too low because owing to the non-corpuscular conception of light, no correction (which varies inversely as the shortest distance from the centre of the Sun) has been made for the pressure of solar light on the star light. As the pressure increases closer to the edge, in taking the mean the stars appearing nearest to the Sun should either be left out or corrected for. My theory predicts that without such a correction there would be a progressive increase in deflection over Einstein's value as one recedes from the edge. My prediction will stand or fall by this test.

II. In the December Number of the *Current Science* extracts from Evershed's paper in the *Observatory* have been quoted. I am obliged to Evershed for referring to the theory of light propounded by me and the two predictions which follow from it.

Evershed has suggested that " Were we situated on the planet Pluto· · · ·, we should certainly be satisfied about General Relativity ", for the medley of shifts in the spectrum can be reconciled by taking the mean of all. I would go further and say: Were we at Sirius where the solar spectral shift from the edge would not be distinguishable from that from the centre, we would persuade ourselves to be convinced of the brilliant triumph of Relativity. Unfortunately for Relativity, we are in a nearer region where we can distinguish one from the other. I have repeatedly pointed out that owing to various causes there is a deficiency in the measurements; up to half the distance from the centre the values, though gradually increasing, are below Einstein's theoretical value; and for the other half, they are above it, and still gradually increasing. The novel method of taking a mean of all values for the purpose of procuring confirmation amounts to shutting one's eyes to the patent fact that the spectral shift is not the same at all points, as Einstein's theory would show, but that there is undoubtedly a rapid and progressive increase as one proceeds from the centre towards the edge. As shown by me at the Science Congress, the effect becomes patent when a curve is drawn for the difference between the spectral shift at any point and the spectral shift at the centre. Royds' results leave no doubt for the value at the edge being double of Einstein's value and in exact accordance with my theory. Even Evershed concedes, " The limb effect remains, however, an unsolved problem."

No doubt Evershed has referred to his measures of the sodium D lines. One solitary swallow cannot make a summer, but I suppose that one set of sodium lines can confirm Relativity. As Professor Stratton of Cambridge declared in his public lecture at the Science Congress, the sodium lines are " minority lines " and do not justify the conclusion that Relativity is confirmed.

My objections to Evershed's observations of the sodium lines are as follows:—

(i) Evershed had not the advantage of a solar eclipse, and had to make observations in full light when the effect of scattering due to light from the centre is great.

(ii) Evershed made measurements in the vaporous atmosphere of England, when scattering due to terrestrial atmosphere is large.

(iii) The sodium D lines are rather broad, which make it more difficult to measure the shift exactly.

(iv) As lines of small wave-length are subject to great refrangibility, measurements of these lines are much more unreliable than those in the red region of the spectrum.

(v) Undisputedly there are convection currents at the surface of the Sun, and measurements of lines at one latitude only may be quite wrong if no correction is made for the possible convection current.

I have repeatedly emphasised that the true test will be furnished by the measurements of the spectral shift of lines in the red region (least subject to refrangibility), preferably at the time of a total eclipse. Royds' observations furnished such a test. Judged by it, my theory has had a cent.

per cent. confirmation, and the Relativity value is wrong by 100%.

III. I shall reply to the criticisms separately.

S. M. SULAIMAN.

New Delhi,
January 28, 1938.

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[1] *Science and Culture*, 1937, pp. 322–23.

I CRAVE the hospitality of your columns to say a few words regarding the communication of Sir S. M. Sulaiman appearing elsewhere in this issue. Since it was I that brought to your notice the article by Eversheds in the *Observatory* (Oct. 1937, p. 266) extracts from which have been published in the December issue of your Journal, I feel it necessary to make some remarks.

It is with great reluctance that I have to call your attention to the title which Sir Sulaiman has chosen for his rejoinder. I may be pardoned for saying that such a procedure, which is unfortunately becoming rather too common, savours more of personal advertisement than of a genuine scientific controversy.

Sir Shah Sulaiman says: "According to my theory there should be an excess of at least 33 per cent." A theory which, on his own statement, is so indefinite can scarcely be expected to be taken seriously. To seek support for it in residual discrepancies between observation and the magnitude of the Einstein shift does not appear to be a useful procedure.

Sir Sulaiman attaches the greatest importance to Dr. Royds' recent eclipse observations and claims that, judged by them, his theory has had a cent. per cent. confirmation. But Dr. Royds' own conclusions[1] do not at all support this contention; for according to Dr. Royds,

"*the relativity theory, or any other theory requiring a general displacement of solar wave-lengths is not adequate* to furnish a complete explanation of solar displacements."

Sir Sulaiman has misunderstood Evershed's reference to a hypothetical observer on the planet Pluto. Evershed has used the illustration just to emphasise the point that relativity gives a satisfactory explanation of the solar spectral shift *in a general sort of way*. It appears therefore hardly fair to remark that he advocates the ignoring of the observed discrepancies altogether, and to suggest that an observation of the Einstein shift be made from Sirius. One might as well suggest an observer on the Andromeda Nebula wherefrom the solar system itself would not be seen!

One thing that is clear from Sir Sulaiman's reply is his belief that every failure of the Relativity Theory automatically means a triumph for his own. If the solitary swallow of the "minority sodium lines" does not make a summer for relativity' a few stray swallows suffice to constitute a summer for his theory. Even the remark of Evershed that the limb effect remains an unsolved problem is seized upon as an evidence indirectly supporting this new theory. When competent and experienced astronomical observers like Dyson and Woolley make the authoritative and unequivocal statement, "But there can be no doubt that Einstein's prediction has been verified" (p. 50 of their book), an attempt has been made to show that their remarks have been misunderstood and that they really do not mean what they say!

It is true that prejudices in favour of an accepted theory die hard, and it is therefore all the more necessary that a new theory which seeks to supplant a reputable one should be entirely free from all the objections raised against the old theory. Sir Sulaiman's theory cannot certainly be said to have achieved this measure of success. Moreover his theory has not yet gone beyond the stage of initial criticism, and, except for a few papers by the author, nor has it been developed in a comprehensive manner worthy of a fundamental physical theory. Until it proceeds beyond the region of mere tinkering with residual discrepancies of observation, and until it produces some striking achievements compelling its acceptance, it is idle to expect that one would throw overboard such an eminently successful and philosophically satisfactory theory as the theory of Relativity.

B. S. MADHAVA RAO.

College of Engineering,
Bangalore,
February 25, 1938.

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[1] *M.N.R.A.S.*, 1937, **97**, 695.

REVIEWS.

Quantentheorie des Elektrons und der Strahlung.—Von H. A. Kramers. (Akademische Verlags-Gesellschaft M. B. H., Leipzig), 1938. Pp. 223-502. Price 26–80 R.M.

This is the second part of the "*Theorien des Aufbaues der Materie*" published in the first volume of the "*Hand-und Jahrbuch der Chemischen Physik*" of Eucken and Wolf. The first part by the same author dealing with the foundations of quantum theory, appeared in 1933. This second part deals with some extensions of quantum mechanics like electron-spin theory. Pauli's exclusion principle and radiation theory, which are of fundamental importance in questions of application of quantum theory to atomic and molecular structure.

It is perhaps as difficult to review books on quantum theory as it is to read them. Ever since the foundations of the theory became sufficiently broad-based, a very large number of text-books has been published from time to time with great differences in the ground covered, in the class of readers to whom they are addressed, and in the method of treatment. Some books have appeared dealing only with special parts of the theory. It is nevertheless true that there are only a few books on which advanced workers in the several fields of modern physics wherein quantum theory is applied mainly rely. Confining ourselves only to books on general theory (without considering the excellent reports, reviews and books on special topics) we might mention Dirac's book, Pauli's article and Frenkel's book—perhaps too narrow and personal a choice. The present book under review will no doubt take its place along with the above three books, as a standard work of reference.

The most important innovation in the book is the comprehensive and clear treatment of the theory of spinors, and its application to Dirac's equation. This is perhaps the first text-book where this topic is dealt with at such great length.

The presentation of Pauli's principle has been made mainly with a view to its numerous applications, and a thorough analysis is made of multiplet situations.

The fundamental principles of the quantum theory of radiation are well brought out in the last chapter. After deriving the general formulæ of absorption and emission by the semi-classical method, the author has fully dealt with the quantisation of the radiation field. As emphasised in the Foreword he has clearly shown that "die Diracsche Strahlungstheorie nicht ohne weiteres als eine Quantelung der klassischen Elektronentheorie zu betrachten ist, sondern —im Gegensatz zu dieser Theorie—nur instande ist, der 'säkularen' Wechselwirkung zwischen Strahlung und Teilchen Rechnung zu tragen"—a statement which, those who have read Fermi's account in the *Review of Modern Physics* will fully appreciate.

This book is to be considered as a classic on the subject.

B. S. M.

Fundamentals of Engineering Electronics. By W. G. Dow. (John Wiley & Sons, New York), 1937. Pp. xiv + 604 with 200 figures. Price $ 4·50.

This book written avowedly for the engineer deals with the main physical ideas and principles underlying the internal action of vacuum and gas electronic tubes and the circuits commonly used with them. In the preface, Prof. Dow very rightly emphasises the importance of a satisfactory understanding of these for the engineer.

The book is divided into two parts; the first 14 chapters relate to vacuum tubes (with thermionic emitters) and a few of the important amplifier and oscillator circuits using such tubes; the subsequent 8 chapters are devoted to gas tubes, thermionic, photoelectric and mercury pool.

The book opens with a discussion of the electric field inside a vacuum triode, the motions of electrons in electric and magnetic fields and the characteristics of cathode rays and their uses for measurements and for television purposes. Then follows a treatment of the space charge phenomenon and the current-voltage relations chracteristic of triodes, tetrodes and pentodes. It is at this stage that the author takes up the subject of

the mechanism of thermionic emission of electrons and the characteristics of the different types of thermionic emitters. And the last three chapters in Part I of the book concern themselves with a few typical amplifier and oscillator circuits. It is rather surprising that there should be no discussion of detectors in the text of the book.

The physical basis of gas tubes is far more complex as it involves the interaction of electrons with matter and of matter with radiant energy. It is thus essential to have an understanding of the atomic structure of matter; of atomic phenomena such as excitation, ionisation and energy radiation and absorption; of the nature and laws of radiation; of the collision between electrons, atoms and photons; and so on. Prof. Dow deals with these in Chapters XV to XVII before taking up the study of phototubes and of the nature and properties of the plasma, arcs and glow discharges. The use of mercury devices both as rectifiers and inverters is dealt with in the last two chapters.

This book is first-rate and ably written for the advanced worker. The discussion is always to the point and lucid; and the mathematical part is confined to what is essential. The mention of the units against the equations and the examples at the end of each chapter are useful features. The book is fortunately not burdened with hundreds of references, even a fraction of which few readers ever look up. A small selected list of references to books and papers is given at the end. Overlapping is avoided by references to these on particular subjects. The author has adopted a rather unusual method of references.

The feature of the book which distinguishes it from others of its type is the noteworthy discussion of the electric field inside a triode contained in Chapter II.

Even the casual reader will note quickly such combination expressions as "off-cathode gradient" (page 44), "space-charge-free gradient" (page 123), "between grid-wires paths" (page 123), "space-charge limited current" (page 188), "between stage-grid batteries" (page 315), etc. Surely, these chain words are not really necessary.

It is perhaps more accurate to call the "rest mass" of an electron as its mass at low velocities instead of at zero velocity (pages 75–76). The term "electron ballistics" is in many ways very apt; but "electron dynamics" is perhaps more general.

The addition of an author index and a list of symbols would have been useful.

RE.

Fundamentals of Physical Optics. By F. A. Jenkins and H. E. White. (McGraw-Hill Publishing Co., Ltd.), 1937. Pp. xiv + 453. Price 30*sh.*

In their preface, the authors of this book state that "the most beautiful and striking experiments in physics are to be found in the field of physical optics". Few physicists would dispute this judgment. The observation of the delicate and sometimes recondite phenomena of interference, diffraction, and polarization calls for the exercise of great experimental skill. There is also a power and completeness in much of the theoretical treatment which gives an intellectual satisfaction not always to be found in other fields. It is to be regretted that with the overloaded syllabuses of the present day, very few students are able to appreciate the delights of this fascinating study.

This latest contribution to the study of physical optics is intended chiefly for advanced under-graduates. Within its limits it reaches, and in places goes beyond, the honours degree standard of Indian universities. Two chapters at the beginning provide a straightforward introduction to the theory of simple harmonic motion and the propagation of waves. The next two chapters deal with interference, the various experimental arrangements for producing interference bands, and the standard interferometers. Then follow three chapters on Fraunhofer diffraction, considering in turn the single slit and the circular aperture, the double slit, and the diffraction grating. One welcomes in Chapter 6 the clear account of the stellar interferometer, which has only recently begun to find its proper place in text-books of optics. Chapter 8 deals with Fresnel diffraction, and the use of Fresnel's integrals and Cornu's spiral in the solution of diffraction problems. Chapter 9 gives a good modern account of experiments on the velocity of light, and in Chapter 10 the electromagnetic theory is briefly treated. Some will regret that Maxwell's equations are not given in vector notation, since it is very desirable that students should have an elementary knowledge of vectors.

The next two chapters are largely descriptive, dealing (Chap. 11) with sources of light and their spectra, and (Chap. 12) with absorption, scattering, fluorescence, and the Raman effect. Then follows a chapter on dispersion, though the full mathematical theory is not given. Four chapters are devoted to polarization and double refraction, the interference of polarized light, and optical activity. The next chapter deals with reflection at the surfaces of dielectrics and metals, and in a final chapter a paragraph or so is given to a brief consideration of each of six magneto-optical and four electro-optical effects.

The authors show a scholarly knowledge of their subject, and have done their work well. The least satisfactory chapters are perhaps 11 and 12, not because of what they contain, which is excellent, but because of what they omit. One would like rather more than 30 lines on the Raman Effect, and a page and a half on "The theory of line, band, and continuous spectra". In fairness to the authors, however, one must note that they do not profess to be writing a book on the quantum theory, and they give cogent reasons for keeping the subject-matter within the limits they have chosen.

Chapters 14 to 18 are well written, but are rather condensed. Such things as the theory of double refraction are necessarily somewhat involved, taxing the imagination of the beginner as he seeks to visualize not only the wave surfaces, but the orientation of the electric vectors and their phase angles. One gets the impression that some expansion is desirable in this part of the book. The high water-mark is reached in the chapters on interference and diffraction, which are a model of lucidity. The diagrams are excellent, and much use is made of graphical methods. One would wish to see some mention of the interesting system of interference fringes described by Milner (*Phil. Mag.*, September 1908), which text-book writers seem entirely to have overlooked. Particular attention must be called to the beautiful photographs which are a feature of the book. Fig. 6*e* for example gives photographs and intensity patterns of the effects produced by diffraction at a double slit, and serves its purpose admirably. The photographs are printed in the text, but many of them deserve a good art paper.

There is a numerical error in Table 9 I, and there are a few misprints but none of them are serious. A misunderstanding is possible on p. 120, where it is not explicitly stated what the angle θ is. Sometimes the American idiom is noticeable. In English you 'plot a graph', in American you presumably 'graph a plot'—at any rate 'plot' is the noun. An occasional reader may be puzzled by 'in back of', until he realizes that it is the opposite of 'in front of'. Of course these small (and quite refreshing) variations of idiom in no way detract from the merits of an excellently written book.

The book has a good index, and the short biographical foot-notes are welcome. Interesting problems, generally involving numerical or graphical computation, are given at the end of the chapters. It need scarcely be added that the printing and binding are of the high standard which we have learnt to expect in the McGraw-Hill Company's publications. The book can be warmly recommended.

H. J. TAYLOR.

A Short History of Chemistry. By Prof. J. R. Partington. (Macmillan & Co., Ltd., London), 1937. Pp. xiii + 386. Price 7*s.* 6*d.*

Recent researches on the history of chemistry have thrown new light on certain aspects of the subject and forced us to revise some of our older views. The need was, therefore, felt for a text-book on the subject, which would incorporate the latest results of these researches. The book under review fully satisfies this need. It is an excellent survey of the history of chemistry from the earliest down to the modern times, written in a clear style, characteristic of the author. The subject-matter is divided into sixteen chapters, covering about three hundred and sixty-four pages. The first chapter dealing with the chemical arts of the ancients, provides the necessary background for a proper understanding of the origin of chemistry, described in the second chapter. The chapter on Alchemy, which is rather too brief, leads on to the work of Paracelsus and Van Helmont, the two most outstanding figures in the history of early chemistry in Europe. "The position of Van Helmont in the history of chemistry is much more important than has usually been supposed. Boyle, in particular, was much influenced by him, and he had expressed doubts as

to the earlier theories of the elements before Boyle" (p. 46). The period between Boyle and the end of the nineteenth century, which is the period of the development of modern chemistry, has received the full amount of attention it deserves, and occupies the bulk of the volume. A special feature of this section is the emphasis laid on the history of physical chemistry which has a chapter to itself. The book closes with an interesting chapter on the structure of the atom, which brings us down to our own times. The value of the book is enhanced by references to original sources, summaries at the end of chapters and a comprehensive bibliography at the end. The book is undoubtedly a most valuable addition to the existing text-books on the subject and an indispensible guide to students preparing for degree examinations.

M. Q.

Science and Philosophy. *Exposes de Philosophie Scientifique—Logical Positivism Pragmatism and Scientific Empiricism.* By Charles W. Morris. (Actualitès Scientifiques et Industrielles No. 449), (Herman, et cie, Paris), 1937. Pp. 72. Price 15 *Fr.*

The exact relation between science or sciences grounded on the methods and data of experimental verification or demonstration under laboratory control and philosophy as systematic inquiry into certain eternal verities like God, Freedom, Immortality and so forth is bound to be a presistent problem challenging a solution, and any attempt at interpretation of the relation between the two must be welcomed. Charles W. Morris, Associate Professor of Philosophy at the Chicago University, has endeavoured to secure harmonization between Science and Philosophy in the course of the *five papers* here brought together under a single cover. It is pointed out in the "Preface" that the new temper of the times demands the approach of "Scientific empiricism". Thus viewed, philosophy as organon becomes general semiotic (which includes syntactics, semantics and pragmatics), philosophy as system....becomes system of unified science, and philosophy as vision is the assessment of the social and cultural implications of the system of knowledge available at any time (p. 5). The net result of the investigation embodied in the papers here collected, is the prominence, almost infallibility, claimed on behalf of what is described to be "Scientific Empiricism" grounded on "a theory of signs", and believed to unite or unify the "main attitudes of formalism, traditional empiricism and pragmatism...." (p. 56).

If "modern rationalism is methodological rather than metaphysical" (p. 71), and if again "mind" is just a "natural process among natural processes", the logical conclusion must be boldly faced and accepted that scientific empiricism must summarily repudiate all values that cannot be *verified*. It means that certain well-known metaphysical concepts and values which from their very nature and constitution cannot admit of demonstration or verification under conditions of laboratory discipline and laboratory *visibility*, must be rejected by scientific empiricism. Emptied of all unverifiable metaphysical content, scientific empiricism will stand restricted to social, economic, political, and of course scientific endeavour.

It is easy to understand that urged by one of the Instincts or Instinct-Groups, as Dr. McDougall and others would have it, mankind is working in the direction of some *ordered existence*, as evidenced by cultural advancement. If that is so, I am unable to see why Prof. Morris is so anxious to make out that "the goal of philosophy and science is *ultimately* the same"* and that "Scientific philosophy is not *ultimately* (sic) different from philosophical science" (Preface). The distinction between "proximately" and "ultimately" is either genuine or spurious. If the former, an artificial synthesis between physics and metaphysics is deplorable. If the latter, there is no need on any rational level or in any scheme of rationalism, either for "Scientific philosophy" or "philosophical Science". More than all this, where should responsibility be located for the antagonism or opposition between laboratory science and philosophy as understood to be non-laboratory? Is science traditionally understood or understood in the light of the temper of the age, as Prof. Morris may like to have it, responsible? Or philosophy? None of these persistent problems would seem to have been squarely faced by Prof. Morris.

Above all, is *philosophic vision* mere "assessment of the social and cultural implications of the system of knowledge *available at any time*" (p. 5).* If knowledge

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* Italics mine.

available to-day alternates between apotheosis of Dictatorship and Democracy, and if notwithstanding all, Sir James Jeans says about nebulæ, light-years, and phenomena of that type, religion understood *not as assessment*, but, as positive ecclesiastical authority or even tyranny, is still a prominent feature of "culture" and if civilized nations should be perpetually preparing for war under cover of pacifism and peace-talk, a philosophic vision which is restricted to assessment of this or that culture must be pronounced to be neither "Philosophic" nor a "Vision". It is no better than a blind struggle for existence in which might must be right. Whether the scientific empiricism envisaged and sketched by Prof. Morris will usher in the millennium should be left an open question, but, in theory and practice, life and philosophy *nothing succeeds like success*. These remarks or reflections notwithstanding, it must be admitted that Prof. Morris has done a great service in the direction of clarification of the intriguing concepts of formalism, pragmatism and empiricism.

R. Naga Raja Sarma.

Ergebnisse der Enzymforschung. Edited by F. F. Nord and R. Weidenhagen. (Akademische Verlagsgesellschaft, m.b.H., Leipzig), 1937. Vol. 6. Pp. x + 289. Price R.M. 23·60.

The sixth volume of the annual has fully maintained the international and expert character of the previous numbers of the series and contains a selection of contibutions of the highest interest to those engaged in enzyme research.

The first contribution by Spek (Heidelberg) is a clear presentation of the recent advances in the study of the pH of the living cells and is of interest to the enzyme chemist who is profoundly interested in questions relating to the action of the cell enzymes as influenced by the pH of the environment in which they are elaborated and function. There are two contributions from Cambridge, one dealing with the kinetics of enzyme reactions by Moelwyn-Hughes and the other on formic hydrogenlyase by Stephenson. Moelwyn-Hughes has given a brief account of the application, to certain enzyme actions, of the chain theory which is one of the most spectacular developments in the recent study of chemical reactions. The theory was first applied, in 1931, by Haber and Willstätter to the decomposition of H_2O_2 by catalase. The earlier views have since received quantitative treatment and in the contribution before us, the theory as applied to oxidation reactions is clearly expounded. The recent developments in the kinetics of non-chain enzyme reactions have also received attention. Stephenson has given a detailed account of formic hydrogenlyase, an enzyme peculiar to bacteria, which decomposes formic acid to hydrogen and carbon dioxide, which was recognised as a distinct enzyme in 1932 as a result of her extensive researches. The interesting question of the formation of hydrogenlyase by bacteria has led her to the conclusion that the enzyme production does not occur in response to "natural selection". The question of enzyme variation in micro-organisms, is an interesting one and in a paper appearing in *Biological Reviews* (1938, 13, 91), Yudkin has given an account of the "mass-action" theory of enzyme production which has several features to commend itself to the attention of enzyme chemists.

There are eight other contributions in the volume under review. The study of Reaction velocities of hydrolytic reactions in a medium containing heavy water, is summarised in a chapter by Bonhoeffer. In a contribution covering over 55 pages, Parnas has discussed the different aspects of the problem of glycolysis in muscle. The rôle of adenosin triphosphate, phosphocreatin and creatin, hexose diphosphate and other intermediates of physiological significance are dealt with in considerable detail. The chemistry of the "yellow enzyme" which plays a very significant part in cell respiration has been dealt with by Theorell. The "yellow enzyme" should hardly be designated an enzyme as it is no more an enzyme than cytochrome is. The study of the chemistry and action of this important respiratory carrier has led to very important developments in the understanding of the mechanism of cell respiration and has brought out the significance of coferments and the pyridene nucleus in hydrogen transference.

Among other contributions, mention must be made of the Enzymology of Tumour Cells, by Köhler in which a full discussion on the activation phenomena of proteolytic enzymes, arginase, etc., is included. Emil Abderhalden has contributed an interesting article

of immuno-biological interest on defense enzymes of the blood serum, almost exclusively belonging to the class of proteinases, whose physiological significance and importance have been brought to light, mainly, if not solely, by his researches. The significant development in the study of immune antienzymes, is brought out in the article on antiurease by Sumner. Von Vita of Bologna has contributed an article on the recent researches on the direct assimilation of atmospheric nitrogen by germinating leguminous seeds. Lastly, we have a contribution on Dilatometry by Sreenivasaya of Bangalore and his collaborator (Miss) Bhagvat who have successfully employed the dilatometer not only for studying the kinetics of a variety of enzymic systems but also for determining the relative digestibility of proteins; its application to the quantitative estimation of sucrose, urea and arginine in plant saps, physiological fluids and protein hydrolysates is indicated. The study of volume changes accompanying enzyme reactions, presents a variety of problems for solution and it is to be hoped that a comprehensive theory of the volume change will soon be formulated, which will rescue the study from the present empiricism.

The usefulness of the volume can hardly be over-emphasised. It is indispensable to everyone interested in the study of enzymes. The next volume of the *Enzymforschung*, covering 437 pages and containing 15 contributions, has just been received. We shall have occasion to notice this volume shortly in these columns.

Hormone bei Wirbellosen Tieren. By Gottfried Koller. (Akademische Verlagsgesellschaft m.b.H., Leipzig), 1937. Pp. 143. Price 11 R.M.

This little monograph represents the first volume of a series on "Probleme der Biologie", edited by Erich Ries and Karl Wetzel. The present book deals in a very interesting and critical manner with the hormones of invertebrates—a subject which had long been neglected but has attracted considerable attention during recent years. A survey giving a critical estimate of this field of investigation is of exceeding importance for comparative physiology and biochemistry.

The author considers the meaning, which is often attached to hormones as products of ductless glands, as too restricted and says that, as in plant physiology, the meaning should be broadened to comprise chemical substances synthesised by the organism, which act specifically and in a regulating manner inside the organism and are effective in very small quantities and are mostly thermo-stable. The book deals in different chapters with the hormones of protozoa, non-glandular and glandular tissue hormones, hormones regulating the metamorphosis of insects, hormones influencing the change in pigment (for instance, in crustacea and in some insects) and glandular hormones in molluscs and tunicates. In addition there is a discussion on the influence of vertebrate hormones on protozoa and invertebrates. There is a very full and up-to-date Bibliography, which will be found to be extremely useful. There is no doubt that this monograph fills a great void in hormone literature dealing as it does with a relatively undeveloped but highly interesting aspect of hormone research. It is hoped that the book will stimulate investigation in this direction in India.

B. C. G.

A Text-Book of Plant Virus Diseases. By Kenneth M. Smith. (J. & A. Churchill, Ltd., London), 1937. Pp. x + 615 with frontispiece and 101 figures including 1 coloured plate. Price 21*s.* net.

Since the discovery of virus infection in plants nearly forty years ago, considerable amount of work has accumulated on the subject. Within the last decade, a great part of the contributions on plant viruses has been distributed in several journals and in departmental bulletins, not available to the average reader. The appearance of the present volume is therefore quite opportune and to be welcomed, coming as it does from the author of the *Recent Advances in Plant Viruses*.

The subject-matter of the text-book covers naturally a vast field, inasmuch as there is not a single food or economic crop but is free from virus attacks including sandal which is the only forest species besides being a root-parasite. Each of the crop plants is affected by more than one virus; as instances may be quoted Tobacco

which has 15, Potato 18 and Tomato only 6. It is thus necessary that a book of the type under review should be more of a reference book with sufficient details to enable the investigator to use them for diagnostic purposes. In this respect, the present volume fulfils all the requirements. A great deal may be said on the arrangement of the details. The author has expressed himself in the preface as to why he adopted James Johnson's classification. It is unfortunate that the subject of plant viruses is still to be systematized notwithstanding the voluminous literature on it. The classifications based on symptomatology, properties of virus, filterability or otherwise of the causative agents or even cytological picture of the infected tissues, have not been successful. None of these will, in fact, adequately serve the purpose. The only hope is that in future, attention will be concentrated on the physiology and biochemistry of the infected hosts, whereby a simple and more useful classification may be evolved.

The first seven chapters in the book deal with the various crop virus diseases. In each case, the author treats of the mode of transmission, reaction of the virus to physical and chemical agents and cellular abnormality like the presence of X-bodies or crystals and ends with a description of symptoms on various species affected by the virus under consideration. Some remarks about sandal will not be out of place here. A great deal of the literature available on this subject does not find mention including the extensive reports and publications on the biochemistry of the disease from the Indian Institute of Science. A useful method of controlling the disease is widely adopted, being found quite adequate and satisfactory. Many years ago, a modification of spike—called " Bronze " spike—was recognised but when healthy leaves were found to develop copper colour normally (due perhaps to host associations) this was omitted from literature. The reviewer feels that the same will happen to sandal virus 1 A. In fact, pendulous spike was in existence years ago, but so also healthy sandal with pendulous branches. The Leaf Crinkle Mosaic of sandal would require a more critical study before being included in a text-book.

In the eighth chapter the insect relation of virus diseases in plants is considered. It is a mystery as to how one insect causes different types of virus diseases and how one and the same disease is transmitted by several vectors. There are many cases in which the carrier of infection is still undetermined or unknown. In all these, control of disease is therefore a complicated problem. In the Punjab, it was believed for a long time that the white fly *B. gossypiperda* M. and L. was responsible for the periodical partial failure of the American cotton, but that proved to be a false alarm. On the other hand, a very virulent type of virus infection, so far not adequately realised and investigated affects this exotic and might account for this trouble. The other virus-infected solanacea plants would serve as alternate hosts for this virus.

In India, there is an unlimited scope for virus disease investigation. It is still not adequately realised by the wise agriculturist or by the Agricultural Council that such infections on crops will reduce the yield and that work should therefore be concentrated on these as early as possible. In the opinion of the reviewer, almost all the useful crops are affected by viruses. It is essential that a systematic and well-planned programme of work should be undertaken without delay. Indian workers find some mention in this book. Sandal spike is a closed chapter but work on Sugarcane mosaic, etc., is still being continued.

A small appendix is annexed to the book and provides a brief summary for each of the virus diseases considered in the text. This adds to the value of the volume enormously. The index is fairly thorough.

The get-up of the book is excellent and priced moderately. It should certainly find a place in all libraries and agricultural institutions. No pathologist could afford to be without it. A slight error on p. 104 has by transposition of the first letter of the words *absent* and *cultivated*, mutilated them out of sense.

V. I.

The Improvement of Indian Agriculture.*

ONE of the conditions laid down when the Imperial Council of Agricultural Research was set up was that the Council's activities should be periodically reviewed by some disinterested experts. It was fortunate that the very first review of this kind should have been undertaken by such two distinguished experts as Sir John Russell and Dr. N. C. Wright. It is a sign of the recognition of the great importance of the cattle and dairy industries of India that it should have been deemed necessary to deal with them separately. Though primarily only the work of the Imperial Council of Agricultural Research was to be passed in review, the terms of reference cover a very wide field. The improvement of Indian agriculture therefore receives very comprehensive treatment in all its important aspects and the reports really constitute yet another landmark in the history of agricultural improvement in this country.

Crop Production.

Sir John Russell has examined not only the various schemes of research initiated and financed by the Research Council but has also looked into the whole of the scientific research work accomplished or in progress in the various Agricultural Colleges, in the Universities and kindred research institutions. He is satisfied that the Research Council has discharged admirably its primary duty of co-ordinating and promoting agricultural research in India, that the methods adopted by them are correct and that a vast amount of work has already been accomplished. Practically every one of the schemes is approved and any suggestions made for modification are generally in the direction of amplifying them by linking them up with important related agencies, both scientific and economic such as the medical, forest, and nutrition research departments and with commercial experts handling produce for the export markets. A fuller use of the British Institutions such as the Imperial Institutes in England dealing with agricultural sciences is suggested and in respect of the control of insect pests in India the recommendation is made that a visiting expert of high standing may be called in for advice. The desirability of employing a first class geneticist is also indicated for putting the work of plant improvement on a less mechanical and more definitely scientific basis. The establishment of a Central Irrigation Research Station is also strongly recommended as the work at present being carried out is scattered, uneven in quality and scale and lacks unified direction. Other suggestions made are for associating the Universities more closely in research work in the sciences basic to agriculture, and for arranging to bring together the results of the work carried out so far on the different crops and other subjects.

Sir John Russell feels strongly, however, that the greater need in India is for "a fuller use of existing knowledge rather than accumulation of more knowledge, for work on the cultivator's fields rather than in the laboratory" and that the Council should apply itself to the task of bringing the results of research into general adoption in Indian agriculture. This matter has been much discussed in the past but an effective method of bringing about such a result within reasonable time is still a desideratum. A fresh orientation of policy towards what is usually known as district work or extensive service is therefore strongly recommended. A visualisation of the improvement of village life in its entirety and for action appropriate thereto is the need stressed strongly, and for this purpose the recommendation is made for materially widening the scope of the Council's work. A developmental side to the Council which will aim to popularise the recommendations of nutrition experts, arrange for the production and distribution of improved seeds on an adequate scale, plan extensions of dairying, fruit and vegetable growing, poultry-keeping and the like, adopt methods of popularising improvements, exploit the results of commercial interest, bring about the settlement of educated men and women on the land and the like, is perhaps the most important recommendation made. The requisite machinery which will enable the Council to carry out these measures is indicated and the need for adequately

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* Report on the work of the Imperial Council of Agricultural Research in applying Science to Crop Production in India," by Sir John Russell, D.Sc., F.R.S.

"Report on the Development of the Cattle and Dairy Industries of India," by Norman C. Wright, M.A., D.Sc., Ph.D.

enhancing the financial resources of the Council is emphasised.

CATTLE AND DAIRY INDUSTRIES.

The report of Dr. Wright is a comprehensive survey of the dairy industry and is enriched with a fund of valuable statistical information relating to India as compared with other important countries. Relieved from the necessity of examining any large research or other schemes, due to the paucity of any such in operation, Dr. Wright has been able to devote a great deal of attention to a study of the existing conditions and to the lines along which the dairying industry should develop. In many important respects the problems are looked at from a different angle altogether from what has been usual so far and supported as they are by a wealth of statistical information his recommendations assume great importance. What is needed in Indian dairying is a new outlook and a new technique, an outlook which recognises the special nature of India's problems and a technique which is designed to meet these problems, as distinguished from the methods and standards of Western countries which have so far influenced and moulded developments in this country. Attention should be thus concentrated on indigenous milk products like *ghee*, curds, etc., and not on table butter, cheese and the like; steps should be taken to increase milk supply for consumption in the *villages* as distinguished from cities; improved methods should be adaptations of local methods rather than totally different foreign ones as the former have been evolved to suit local conditions.

Dr. Wright is naturally struck with the heat treatment and the souring of milk into curds, the two methods so universal in this country as admirably suited to the conditions here and would generally discount the value of refrigeration and similar methods, on economic grounds. Improvements in the production and marketing of *ghee*, in the preparation and sale of other typically Indian dairy products are therefore greatly stressed and conformably to the general trend of his opinion, the production of cheese, the manufacturing of condensed milk, milk powder and so on and large-scale creamery butter are not recommended as matters of importance. The whole scheme of the creamery at Anand for which a provision of Rs. 6 lakhs has been sanctioned is likewise recommended to be kept in abeyance. One has nevertheless to note that India is advancing along Western lines in its industrialisation and the growth of cities and that methods perfected elsewhere to meet such conditions cannot be ignored. It is also doubtful if village life can ever afford the necessary stimulus to milk production as the cities to which alone the present progress in dairying is due. As a means of cheapening milk production the claims of mixed farming are emphasised. One may hope that this may be taken up for demonstration and popularisation. For the improvement of milk yields of Indian cows, Dr. Wright is emphatically against cross-breeding with foreign breeds and recommends the systematic building up of herds of high yielding, indigenous breeds of cows. The buffalo is, however, the premier milk producing stock of India, and more attention in respect of selection and breeding from high yielding stock is suggested. An important suggestion towards increasing the supply of concentrated cattle feeds is that the export of vegetable oils should be encouraged in preference to that of oil-seeds so as to retain the oil-cakes for local consumption.

The need for research in practically every aspect of dairying under the special conditions of India having been emphasised, Dr. Wright proposes for practical action, the opening of an Imperial Dairy Research Institute both for research and for advanced special training. The improvement of the dairy course in Provincial Agricultural Colleges to the standard required for the I.D.D. Examination and the expansion of dairy instruction in Veterinary Colleges are also suggested. The appointment of a Dairy Development Officer in the provinces is recommended as a first step in establishing a regular Dairy Advisory Service. Suggestions are also given for a proper co-ordination between the allied agencies.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
University Librarian, Madras

Bowditch, Nathaniel (1773–1838)

NATHANIEL BOWDITCH, an American mathematician, was born in Salem, Mass., March 26, 1773. His father was a cooper. The family's poverty led to the withdrawal of Nathaniel from school when he was but ten. But "Learning came natural to him". The following incident in his short school career will be of interest to the teaching profession. When he was about six years, his teacher, a person of violent temper, gave him a difficult sum in arithmetic. The pupil went to the desk and soon brought up the slate with the question solved. The teacher, surprised at the quickness of his return, asked him who had been doing the sum for him; and on assuring "Nobody—I did it myself" the teacher gave him "a severe chastisement for *lying*, not believing it possible that he could, of himself, without any assistance, perform so difficult a question".

Prepares Almanac at 15

On leaving school, he became a clerk in a ship-chandlery and remained as such till 1795. But every moment that he could snatch from the counter was given to the slate. An old gentleman said to his wife, "I never go into that shop but I see that boy ciphering and figuring away on his slate....If he goes on at this rate....I should not at all wonder if, at last, in course of time, he should get to be an almanac writer". This expectation was speedily fulfilled; for in 1788, when he was only fifteen, he actually made an almanac for 1790. The original manuscript is said to be still in the family.

Ardent Love for Reading

He had an ardent love for reading. During this period, he read through the whole of *Chambers' cyclopædia*, without omitting a single article. He read Euclid. He learned algebra, borrowing a text-book from a local teacher. He learned Latin to read Newton's *Principia*. The *Philosophical transactions of the Royal Society of London* and many other similar works came his way to delight and enrich him by an accident, which was described by him as follows in his last will :—

An Accident Favours

A valuable scientific library was captured in the British Channel (on its way to Ireland) by an American privateer. And it was deposited in the Salem Atheneum. "Thus in early life, I found near me a better collection of philosophical and scientific works than could be found in any other part of the United States....I was permitted freely to take books from that library and to consult and study them at pleasure."

Practical Navigator

From 1795 to 1804, he followed a nautical career. During this period, he revised the thirteenth edition of J. H. Moore's *Practical navigator* and brought out a corrected American edition (1799). But he found the book to be "a tissue of errors from beginning to end". In fact, he had to correct "*eight thousand* errors in the nautical tables". This made him issue the corrected book in his own name under the title the *New American practical navigator* (1800). This useful book went through 56 editions. The scholarship displayed in the book won for him an honorary degree of M.A. from the Harvard University (1802).

His Later Career

In 1804, he retired from the sea-faring life and became President of an Insurance Office at Salem. Later in 1823 he went to Boston as the Actuary of the Massachusetts Hospital Life Insurance Company, a position which he held till his death.

Lissajous Curves

During this part of his career he pursued his scientific work to a remarkable degree. He surveyed and made accurate charts of the harbours of Salem, Beverley and Manchester. He published as many as 23 scientific papers in the *Memoirs of the American Academy of Arts and Sciences*. While most of them relate to Astronomy, the ninth paper (1815) entitled *On the motion of a pendulum suspended from two points* was the mathematical exposition of a problem which became famous, many years later, in connection with certain acoustic phenomena, as Lissajous curves.

Celestial Mechanics

A monumental contribution of Bowditch was the translation, with profuse commentary, of Laplace's *Mechanique celeste* in four volumes (1829–39). In the words of His Royal Highness the Duke of Sussex, as President of the Royal Society, "In Dr. Bowditch's very elaborate commentary every deficient step is supplied, every suppressed demonstration is introduced, every reference explained and illustrated, and a work which the labours of an ordinary life could hardly master, is rendered accessible to every reader." Laplace himself is said to have remarked, "He has not only detected my errors, but he has also shown me how I came to fall into them."

His Faith in Books

Among the numerous services which Dr. Bowditch rendered to the cause of good learning and the diffusion of useful knowledge after he came to Boston was the active interest he took in the Boston Atheneum. He fought hard and succeeded in breaking the blind tradition of refusing loan of books from its splendid library. He met with strenuous opposition in this attempt. But he knew the value of books and he believed and said that the circulation of books would make the library ten times more useful. He persevered till he won his object. He also exerted himself in enriching the collection in the library and making the conditions of loan extremely easy.

After a short period of illness due to some gastric trouble Bowditch died on Friday, March 16, 1838.

Perkin, William Henry (1838–1907)

WILLIAM HENRY PERKIN, a British chemist, was born at Shadwell, March 12, 1838. His father was a builder. William received his early education at a private school, and was afterwards sent to the City of London School, where the enthusiasm of Thomas Hall fixed his interests definitely in chemistry. The following account of Perkin himself will be of interest:

Choice of a Career

"As long as I can remember, the kind of pursuit I should follow during my life was a subject that occupied my thoughts very much. My father being a builder, the first idea was that I should follow his footsteps and I used to watch the carpenters at work and also tried my hand at carpentry myself. Other things I noticed led me to take an interest in mechanics and engineering, and I used to pore over an old book called *The Artisan* which described some of the steam engines then in use, and I tried to make an engine myself··· I had always been fond of drawing···This led me on to painting and made me think I should like to be artist···But when I was between twelve and thirteen years of age, a young friend showed me some chemical experiments and the wonderful power of substances to crystallise in definite forms, and the latter especially struck me very much, with the result that I saw there was in chemistry something far beyond the other pursuits with which I had previously been occupied···My choice was fixed and I determined if possible to become a chemist, and I immediately commenced to accumulate bottles of chemicals and make experiments."

His Career

In 1853, Perkin entered the Royal College of Chemistry as a student of Hofmann. In 1854 he fitted up a laboratory in his own home. Inspired by some remarks of his professor, he tried to synthesise quinine but obtained a black product from which he was able to extract a bluish substance with excellent dyeing properties. This led to his taking up a patent and setting up dye-works at Greenford Green in 1857. It proved to be a flourishing business. About 1874, having put by enough money, he abandoned his business and devoted himself exclusively to research.

Synthetic Chemistry

The first epoch-making discovery of Perkin was the "Mauve," a synthetic dye. This discovery ultimately led to the supersession of vegetable by synthetic dyestuffs. Next, Perkin discovered processes for the manufacture of artificial alizarin. He succeeded in synthesising several other substances as well. He described these processes in about ninety papers published mostly in the *Transactions* of the Chemical Society.

Physical Chemistry

In 1881, he turned his attention to physical chemistry, and by a systematic study of

the magnetic rotatory power, he delved into the chemical constitution of substances. In the words of Prof. Bruhl of Heidelberg, this work of Perkin "created a new branch of science".

His Honours

Perkin's services were widely recognised. He received several medals and several honorary degrees. In July 1906, the Golden Jubilee of Perkin's creation of the coal-tar dyeing industry was celebrated, practically all the countries participating in it, and he was knighted. Perkin Medals were founded.

After four days' illness, Perkin died of double pneumonia at his residence at Sadbury, July 14, 1907.

ASTRONOMICAL NOTES.

Planets during April 1938.—Mercury can be seen as an evening star early in the month; on April 21 it passes conjunction with the Sun and about the end of the month, will be visible in the eastern sky, just before sunrise. Venus can be seen low down in the west for about an hour after sunset; it will closely approach Uranus on April 15, when the angular distance between the two planets will be only 9 minutes of arc.

Mars will not be well placed for observation during the month, being too near the horizon in the western sky at sunset; it will be in conjunction with the Moon on April 3, the planet being 42′ south of the Moon at the time. Jupiter will be a fairly bright object in the sky in the latter part of the night, rising about 2 hours after midnight. Saturn also can be seen near the eastern horizon about an hour before sunrise. The ring ellipse is gradually widening, the major and minor axes being 36″ and 5″ respectively about the middle of April. Neptune is situated about 2° to the north-west of the star τ Leonis and can be picked up with a binocular.

Occultations of Stars by the Moon.—The observations of occultations provide valuable material for determining the errors of the Moon's position as given in the Ephemeris. From a discussion of the results of 1405 occultations observed at various places in 1935 (*Astronomical Journal*, 1076), Prof. E. W. Brown and Dirk Bronwer have found the mean correction to be $+3''{\cdot}41$ in longitude and $0''{\cdot}53$ perpendicular to the plane of the Moon's orbit. The mean correction, it may be noticed, is slowly decreasing from a value of about 7″ in 1926.

Galactic Rotation.—Planetary nebulæ, like globular clusters are recognized to be remote members of the stellar system. The number of planetary nebulæ known at present is about 150; and they are situated at distances varying from 500 to 12,000 *parsecs*. From a study of the distribution and motions of these objects, Prof. Louis Berman has obtained (*L.O.B.*, 486) a new determination of the constants defining the rotation of the galaxy. The direction of the centre of rotation is given by $l_0 = 333°{\cdot}0$ and the distance of the Sun from the centre is estimated to be 9360 *parsecs*. The period of its orbital revolution about the galactic centre is 210 million years. The results appear to be in good agreement with those derived from the investigations of Oort as well as Plaskett and Pearce. (The unit of distance—one *parsec*—is equal to 3·26 light years).

T. P. B.

RESEARCH ITEMS.

Relations between the Melting Points, Boiling Points and Critical Constants of Homologous Compounds and the Number of Carbon Atoms they Contain.—In the *Proceedings of the Koninklijke Akademie van Wetenschappen of Amsterdam*, 1937, **40**, 164, J. H. C. Merckel has adduced a number of formulæ which satisfactorily represent the melting points, boiling points and critical constants of a number of compounds of the paraffin series as a function of the number of carbon atoms they contain (n). The following formulæ are taken from his paper:

(1) *Melting point.*—If T° K is the melting point and n the number of carbon atoms contained, the formula

$$\log T = -\frac{2\cdot091}{n-1} + 2\cdot6018$$

represents the melting points of the odd members $C_{11}H_{24}$, $C_{13}H_{28}$ ··· up to $C_{35}H_{72}$ within an error of 1°. The melting points approach the limiting value 399°·8. The agreement is not good for the members previous to $C_{11}H_{24}$.
The formula

$$\log T = -\frac{1\cdot870}{n-1} + 2\cdot5896$$

holds for the even members from $C_{10}H_{22}$ to $C_{24}H_{50}$. From $C_{24}H_{50}$ up to $C_{60}H_{122}$, we have the formula

$$\log T = -\frac{2\cdot284}{n-1} + 2\cdot6136.$$

(2) The boiling points at 76 cm. pressure are represented by

$$\log T = 0\cdot212 \log\{(n-1)^2 - (n-1) + 1\} + 2\cdot2546.$$

This holds for both the odd and even members of the series. The boiling points at 15 mm. pressure follow the formula

$$\log T = 0\cdot1986 \log\{(n-1)^2 - (n-1) + 1\} + 2\cdot1758.$$

(3) The critical temperatures T_{cr} are given by

$$\log T_{cr} = 0\cdot159 \log\{(n-1)^2 - (n-1) + 1\} + 2\cdot4957.$$

(4) The critical pressures P_{cr} are represented by

$$\log P_{cr} = -0\cdot346 \log\{(n+2)^2 - (n+2) + 1\} + 2\cdot0747.$$

T. S. S.

Mass Spectrograph and Isotopic Weights.—Prof. Aston has improved his mass spectrograph so as to give second order focussing and in *Proc. Roy. Soc.*, (A), 1937, **163**, 391, he gives the values he has recently obtained for a number of isotopes. Table I gives his results. Provisional values are included within brackets.

Prof. Dempster has also determined the masses of a number of heavy atoms using a double focussing spectrograph and his new spark discharge source of ions. The following results (Table II) are from his paper in *Phys. Rev.*, 1938, **53**, 64.

TABLE I.

Symbol	Packing Fraction	Isotopic Weight	Symbol	Packing Fraction	Isotopic Weight
^{1}H	+ 81·2	1·00812 ± 0·00004	^{35}Cl	− 5·71	34·9800 ± 0·0008
^{2}D	+ 73·55	2·01471 ± 0·00007	^{37}Cl	− 6·10	36·9775 ± 0·0008
^{4}He	+ 9·77	4·00391 ± 0·00016	^{36}A	− 6·10	35·9780 ± 0·0010
^{10}B	+ 16·1	10·0161 ± 0·0003	^{40}A	− 6·15	39·9754 ± 0·0014
^{12}C	+ 2·96	12·00355 ± 0·00015	^{78}Kr	− 7·30	77·9430 ± 0·0020
^{14}N	+ 5·28	14·0073 ± 0·0004	^{82}Kr	− 7·70	81·9369 ± 0·0015
(^{16}O	+ 3·2	18·0057 ± 0·0002)	^{84}Kr	− 7·60	83·9362 ± 0·0015
^{19}F	+ 2·36	19·0045 ± 0·0005	^{86}Kr	− 7·40	85·9363 ± 0·0015
^{20}Ne	− 0·70	19·9986 ± 0·0006	(^{118}Sn	− 5·8	117·930)
(^{27}Al	− 3·3	26·9909)	(^{120}Sn	− 5·8	119·930)
^{8}Si	− 4·90	27·9863 ± 0·0007	^{129}Xe	− 4·46	128·9424 ± 0·0020
^{29}Si	− 4·7	28·9864 ± 0·0008	(^{132}Xe	− 4·4	131·942)
^{31}P	− 5·30	30·9836 ± 0·0005	(^{200}Hg	+ 1·4	200·028)
^{32}S	− 5·53	31·9823 ± 0·0003			

TABLE II.

Mass No. m	Ions	Diff. of Packing Fractions $(f_2 - f_1)$	m	Ions	$f_2 - f_1$	m	Ions	$f_2 - f_1$
16	O – Ti	– 7·22 ± 0·1	116	Sn – Th	10·14 ± 0·1	99	Ru – Pt	8·26 ± 0·2
12	C – Ti	– 9·8 ± 0·4	119	Sn – U	10·41 ± 0·1	69	Pd – Ga	1·29 ± 0·3
14	N – Fe	–12·3 ± 0·4	91	Zr – W	7·85 ± 0·2	71	Pd – Ga	1·37 ± 0·3
16	O – Cu	– 6·9 ± 0·2	92	Zr – W	8·05 ± 0·2	94	Mo – Os	7·78 ± 0·3
27	Al – Ag	– 1·2 ± 0·2	97	Mo – Pt	7·7 ± 0·2	95	Mo – Os	7·76 ± 0·3
65	Cu – Pt	8·93 ± 0·1	98	Mo – Pt	7·68 ± 0·2	96	Mo – Os	7·58 ± 0·3
65	Cu – Au	8·90 ± 0·2	96	Mo – Ir	7·72 ± 0·2	19·5	K – Ru	0·4 ± 0·3
49	Au – Ti	9·36 ± 0·2	95·5	Mo – Ir	7·68 ± 0·2	20	Ni – Ru	1·1 ± 0·3
54	Ag – Fe	2·55 ± 0·3	104	Pd – Pb	7·96 ± 0·15	27	Al – Pd	1·6 ± 0·3
21·3	Ag – Zn	2·0 ± 0·3	102	Pd – Pb	8·07 ± 0·2	117·5	Sn – AcU	10·5 ± 0·3
22	Ag – Zn	2·5 ± 0·3	103	Rh – Pb	7·96 ± 0·15	96	Mo – Pt	8·3 ± 0·3
23	Na – Zn	4·9 ± 0·5	102	Pd – Tl	8·03 ± 0·2			
			104·5	Pd – Bi	7·84 ± 0·1			
			96	Ru – Os	7·91 ± 0·2			

Then assuming f_1 for O to be 0, f_2 for Ti 48 is deduced as $-7{\cdot}22 \pm 0{\cdot}1$ and so on.

T. S. S.

Dilatancy and its Relation to Thixotropy.—An interesting study, "on the relation between dilatancy and thixotropy" has been made by H. Freundlich and H. L. Röder (*Trans. Farad. Soc.*, 1938, **34**, 308). An example of dilatancy is to be found in moist quartz sand which whitens and appears dry as the foot falls on it and becomes wet again on raising the foot. A part of dilatant mass can be cut out with a spatula as if it were a solid cake while immediately after this, it flows down the spatula like a treacly liquid. Dilatancy may be considered to be an opposite to thixotropy. In thixotropic systems, viscosity decreases by stirring and increases on standing whereas dilatant systems on stirring exhibit increased resistance to deformation.

Dilatancy is readily observed only in a rather narrow range of concentration; in quartz-water suspension only between 42 per cent. and 45 per cent. of solid per volume. Rice starch and potato starch also exhibit this phenomenon at about the same concentration. For dilatancy, absolute independence of particles from one another is essential. Tendency to adhere reduces dilatancy.

In order to measure the degree of dilatancy, an apparatus has been devised, by which the speed of a sphere moving in a dilatant system is measured in relation to the driving force, *i.e.*, the rate of shear in relation to shearing stress. At a low rate of shear, the mass behaves like an ordinary viscous liquid. At a certain rate of shear, however disproportionately high, resistance sets in and any further increase of the shearing stress has no effect on the speed of the sphere.

The mechanism of dilatancy is interesting. At low rates of shear the particles in front of the sphere have sufficient opportunity to slip over each other. At a certain rate of shear when dilatancy sets in, shearing process may become so rapid that the particles are no longer able to "make way" but are piled up in front of the moving sphere and create a considerable resistance. Behind the sphere the mass is stretched, cracks may form which become filled with the liquid. The local accumulation of the solid particles on one side of the moving sphere and gathering of liquid in cavities on the other, causes such a system to behave like a solid. Similar structure is supposed to exist in thixotropic systems. In dilatant systems the solid state is unstable, kept up only by external force and with the removal of the force, the particles having no tendency to adhere distribute more uniformly. Thus the system becomes fluid and remains so. The mechanical treatment therefore causes a change from a more regular "fluid" distribution of the particles into an irregular "solid" distribution. In thixotropic systems however particles having a tendency to adhere, the irregular solid distribution is more stable but on shaking the system becomes fluid owing to more uniform distribution.

Besides the above systems, with microscopic particles, systems containing ultramicroscopic

particles like a concentrated solution of potassium silicate containing a certain amount of silicic acid and Nuodex calcium—S (a colloidal solution of 10 per cent. calcium naphthenate in petroleum distillate) are found to show dilatancy.

Quartz powder and starch grains with non-polar liquids like benzene and carbon tetrachloride, etc., form thixotropic pastes whereas with polar liquids like water, ethyl alcohol and glycerol show dilatancy. This is due to the fact that particles of quartz and starch in water, being charged have no tendency to adhere whereas in non-polar liquids, being uncharged or poorly charged adhere and form clusters. Thus thixotropy in many respects is the opposite of dilatancy.

K. S. RAO.

Nerve Distribution in the Muscles of the Ox.—A very valuable and interesting treatise dealing with the distribution and deviations of important nerves and blood vessels in the anatomy of the ox has recently appeared. ("Investigations on the Course and Distribution of the Nerves supplying Levator anguli scapuli and Rhomboideus muscles and the Formation of the Phrenic Nerve in the Ox, with Observations on Certain Anatomical Deviations," by H. N. Chelva Ayyangar, pp. 60, 55 illustrations. Published by the Manager of Publications, Delhi, 1937, Price Rs. 4–10–0.) The author has to be congratulated on the valuable discoveries of certain important variations which may be of immense use in correctly assessing the functions of certain organs in the ox. Text-books on the anatomy of domesticated animals invariably deal with the anatomy of the horse, only important differences in other domesticated animals being described casually. The author has done an immense service to the veterinary profession in opening up a new line of work especially for us in India who are to deal more with the ox tribe in our daily routine.

A few of the important findings of the author in his own words are:—1. The usual nerve supply to the levator anguli scapuli is from the 5th to 8th cervicals. Very frequently, it is also supplied by a branch from the 4th. 2. The nerve supply to rhomboideus, generally, is from 5th and 6th cervicals. It often gets a supply from the 4th also. Occasionally, branches from the 7th contribute towards the nerve supply of this muscle. 3. The nerve supplying the levator anguli scapuli and rhomboideus, besides being more flexuous than in the horse, show very frequent anastomosis which condition is not met with in the horse. 4. The formation of flattered and various shaped fasciculi at the junction of the various nerves supplying the rhomboideus on the deep face of the muscle, the coursing backward of the united nerve in an arch-like manner giving off twigs (entering the deep face of the rhomboideus) mostly from its dorsal face and the ease with which the common cord could be traced to the most posterior part of the dorsal rhomboideus all along its deep face are points not experienced in the dissection of the "Nerve to rhomboideus" in the horse. 5. (*a*) The branches from the 5th, 6th and 7th usually form the roots of the phrenic nerve in the ox. (*b*) The branch from the 5th which is inconstant in the horse, is always present in the ox. (*c*) The branch from the 5th is the largest and the longest and is *always placed on the deep face of the scalenus.* (*d*) The branches from the 5th and 7th are *always on the superficial face of the scalenus.* (*e*) Sometimes, a branch from the 4th cervical nerve also forms one of the roots of the phrenic nerve. (*f*) The branch from the 7th is the shortest and the narrowest. (*g*) The branches from the 6th and 7th first unite and this cord then enters the thorax where it is joined by a branch from the 5th behind the level of the first rib. (*h*) When the 4th nerve enters into the formation of the phrenic, the branch from the 4th first unites with that from the 5th and the common cord resulting from this meets the common cord formed by the union of the branches from the 6th and 7th in the thorax.

S. D. A.

The Hällefors Dolerite Dike and Some Problems of Basaltic Rocks.—In a valuable contribution appearing in the *Bulletin of the Geological Institution of the University of Upsala*, (1937, **26**, 113), Krokström dealt with the arresting problems of Basaltic Rocks,—tracing the genesis of their differentiation to a common parent stock,—and particularly of the contrasted types, granites and dolerites. He attempts to solve also some of the problems connected with the mineral associations of the rocks, namely, the association of monoclinic and Orthorhombic pyroxenes, the crystallisation of diabantite and ferrite as mutually exclusive members and the order of crystallisation of Olivine, Plagioclase, Pyroxene, and iron ores. Then he goes on to examine the theories of Bowen, Fenner, Holmes and Kennedy to find a suitable explanation for the occurrence of the contrasted types,—the Breven and Hällefors dolerites, and their associated granophyres.

To this end he has worked out extensive optical, chemical and petrographic data of the minerals and rocks under study. Some of the following conclusions of his deserve notice.

While estimating the anorthite content of plagioclases he points out that the extinction angles are really controlled by the anorthite content and the mutual proportions of alkali silicates are of very little influence. That TiO_2 in the pyroxene tends to lower the value of $2V.\gamma$ is another observation.

He further points out that the textural relationship of basic rocks is influenced by the silica content. Thus the ophitic texture is developed in undersaturated rocks and the doleritic texture (British "Intergranular") in rocks, where there is an enrichment of silica in the residuum. He says that the same result would follow if the residuum were enriched in iron.

For the origin of the associated granophyre dykes he rejects the "Acid Residuum" theory of Bowen, and admits Holmes' "Partial Refusion" theory as the more tenable, and classifies the dolerite magma of the above dykes as belonging to Kennedy's Olivine-Basalt Magma type.

The Problem of Plateau.

A CLASSICAL problem in the calculus of variations is to prove the existence of a surface of least area bounded by a given contour Γ. The Euler conditions of this variational problem form a system of non-linear partial differential equations, expressing that the required surface has mean curvature zero, or, is a "minimal surface". This problem of finding a minimal surface to pass through an assigned boundary—called Plateau's Problem, derives an exceptional interest from the circumstance that the surface can always be exhibited to the eye by a simple physical experiment. Dip a wire having the form of the given boundary-curve in soap-solution, and the film adhering to the wire when withdrawn from the solution is the surface required. Simple examples are furnished by the catenoid and the helicoid which correspond to the case when the bounding curve is a pair of equal pair circles, and a helix respectively. It is known from the theory of surface-tension that a very thin film must assume that form for which the surface-area is a minimum and that for such a surface the mean curvature vanishes at every point. Various forms of such surfaces of revolution were produced experimentally by J. A. F. Plateau who made an elaborate study of the phenomena of surface-tension and greatly facilitated the study of liquid films. (*However, while investigating these beautiful phenomena, he himself never saw them, having lost his sight in about* 1810.) Although the existence of a minimal surface passing through a given curve can be demonstrated simply by such experimental methods, it is remarkable that no *theoretical* proof of existence in the general case was known till very recently, when in about 1931–32, Radò and Douglas succeeded independently in giving a satisfactorily general existence proof. This appears all the more remarkable if we reflect that the names of such great mathematicians as Riemann, Weierstrass, H. A. Schwarz, Darboux and others are associated with the problem. Riemann, and after him Weierstrass and others succeeded in linearising the differential equations of the problem, showing that Plateau's problem is equivalent to finding a potential vector X (u, v) in a domain B of the u, v-plane (boundary C) which gives a conformal mapping of B on a surface bounded by Γ (the given boundary-curve of the minimal surface), and on the basis of this definition obtained the solution for many interesting particular cases. Douglas has indeed considered the much more general and difficult problem of proving the existence of a minimal surface in an m-dimensional space, which is bounded by k given contours (Jordon curves) $\Gamma_1, \Gamma_2, \cdots \Gamma_k$ and which has a prescribed topological structure, *i.e.*, is required to be one-sided or two-sided and to have a prescribed genus. He has so far published a solution for two-sided minimal surfaces of the genus zero for $k = 1$ and $k = 2$, and also one-sided surfaces (the type of a Mœbius band) with $k = 1$, and he has announced a solution of the general problem in which he will make essential use of the theory of Abelian functions on Riemann surfaces of arbitrary genus. In the meanwhile, R. Courant has developed (*Annals of Math.*, 1937, **38**, No. 3, 679) an independent method on the line of Dirichlet's Principle which not only solves the original Plateau problem and the most general problem formulated by Douglas but is also capable of yielding solutions for the problem in cases apparently not accessible to Douglas' original method, in which parts of the boundaries are free on prescribed manifolds of any dimension less than m.

The problem may be formulated analytically as follows:—Suppose that the surface S under consideration to be represented by functions x_μ (u, v) of two parameters (u, v), (or by a vector X (u, v) with the x_μ as components) in a given domain B of the u, v-plane with boundary C.

These functions shall be continuous in B + C, have piecewise continuous second derivatives in B, and map Γ on C. Then the problem is to minimise by one of these admissible functions the integral $A(X) = \iint_B \sqrt{EG - F^2}\, du dv$, where with the usual notation

$$E = \sum_\mu \left(\frac{\partial x_\mu}{\partial u}\right)^2, \quad G = \sum_\mu \left(\frac{\partial x_\mu}{\partial v}\right)^2, \quad F = \sum_\mu \frac{\partial x_\mu}{\partial u}\frac{\partial x_\mu}{\partial v}.$$

Since the integral A is invariant under arbitrary transformations of the parameters (u, v) and their domain B, the latter, if Γ is a simple Jordan curve, may be chosen as the unit circle $u^2 + v^2 < 1$. It is then shown easily that the problem is equivalent to the problem of minimising the classical Dirichlet integral $D(X) = \frac{1}{2}\iint_B (X_u^2 + X_v^2)\, du\, dv$. The proof of the existence of a solution is carried out on the basis of the known solution of the boundary-value problem of the potential equation $\nabla^2 p\,(u, v) = 0$ for a domain in the u, v-plane bounded by k circles $C_1, C_2 \cdots C_k$, and a series of Lemmas of which the most important are the following:—

(1) Suppose that in a domain B of the u, v-plane bounded by k circles $C_1 \cdots C_k$, the vector $X(u, v)$ is continuous and has piecewise continuous derivatives in B and $D(X) \leqslant M$, and maps the circles $C_1 \cdots C_k$ in a continuous way on the prescribed Jordan curves $\Gamma_1 \cdots \Gamma_k$ in the m-dimensional X-space. Let O be a point in B or outside B, C_r the part of the circle with radius r round O lying in B. Then there exists for every sufficiently small δ a value r_0 with $\delta \leqslant r_0 \leqslant \sqrt{\delta}$, so that on every connected arc of C_{r_0} the oscillation of the vectors X does not exceed the quantity $\epsilon(\delta) = [4\pi M / |\log \delta|]^{\frac{1}{2}}$. In particular, for O on C and δ so small that C_r consists of a single arc, there exist two points A_1, A_2 on C at the same distance r_0 from O with $|X(A_1) - X(A_2)| \leqslant \epsilon(\delta)$.

(2) Let R on C_ρ be a point of non-equicontinuity for a sequence of vectors $\{X_n\}$ which satisfy the assumptions of the above lemma and map

C_ρ on a Jordan curve Γ_ρ in a monotone continuous way. Let b be a fixed arc on C_ρ with end-points A, B containing the point R but otherwise arbitrarily small and let b' the complimentary arc of C_ρ. Then at least for a subsequence X_n the image β of b defined by X_n will cover all Γ_ρ, except for an arc β' whose diameter tends to zero as n increases. In other words: the mapping of C_ρ on Γ_ρ by X_n tends to a degeneration in such a way that any small neighbourhood of a point R is mapped on nearly the whole closed curve Γ_ρ. Since the Dirichlet integral D (X) is invariant under conformal mapping, we may by a linear transformation, transform the unit-circle into itself so that 3 given points on C are co-ordinated to three fixed points on Γ. Assuming that this 3-point condition is satisfied and that the Dirchlet integral is capable of finite values, the solution of Problem I for a single contour $\Gamma(k=1)$ is obtained as follows: There exists a minimising sequence $X_1 \cdots X_n \cdots$ of admissible vectors for which $D(X_n) \to d$ for $n \to \infty$ while always $D(X_n) \geqslant d$ [d = lower bound of D (X)] and so these Dirichlet integrals are bounded. The boundary values of the X_n are equi-continuous, since otherwise by the choice of a suitable subsequence we would have a point R of non-equicontinuity on C and this by lemma (2) above contradicts the 3-point condition which excludes the possibility of an arbitrarily small arc b of C being mapped on nearly the whole curve Γ. On account of the equi-continuity we can choose a subsequence of the X_n—again called X_n—which converges uniformly on C. With these boundary values we solve the boundary-value problem of $\nabla^2 X = 0$ for B and thus obtain a sequence of potential vectors having the same boundary values as the X_n and having Dirichlet integrals not exceeding D (X_n), according to a known theorem which asserts that the minimal value of the Dirichlet integral is attained for and only for the function which solves the corresponding boundary-value problem. Since the new potential vectors are also admissible vectors in Problem I, they form a minimal sequence $\bar{X}_1 \cdots \bar{X}_n \cdots$ and the uniform convergence of their boundary-values implies their uniform convergence in B + C to a potential vector $X = \lim_{n \to \infty} \bar{X}_n$. satisfying the conditions of Problem I and $\nabla^2 X = 0$ in B. In each concentric circle the derivatives of X_n converge uniformly towards the derivatives of X. Denoting by D_r the Dirichlet integral for a concentric circle of radius $r < 1$, we have therefore $D_r(X) = \lim_{n \to \infty} D_r(X_n) \leqslant \lim_{n \to \infty} D(X_n) = d$. Letting $r \to 1$ we obtain $D(X) \leqslant d$ and since the inequality sign would contradict the assumption that d is the lower bound, we have $D(X) = d$, *i.e.*, X solves Problem I. To prove that the solution defines a minimal surface, use is made of the remark that in using the minimising character of X we need not observe the 3-point condition nor the potential character of X, to replace X by $z(r, \theta) = X(r, \phi)$ with $\phi = \theta + \epsilon\lambda(r, \theta)$, λ arbitrary with continuous first and second derivatives in B + C. Since z satisfies the conditions of Problem I, $D(z) \geqslant d$. Passing to the limit $\epsilon \to 0$, it is shown that this leads to the condition $\lim_{r \to 1} \int_0^{2\pi} \lambda(r, \theta)\, r\, X_r\, X_\theta\, d\theta = 0$. Now have $w^2\phi(w) = \sum_\mu \left(\frac{df_\mu}{d \log w}\right)^2 = \sum_\mu \left(r\frac{\partial x_\mu}{\partial r} - i\frac{\partial x_\mu}{\partial \theta}\right)^2$ and so $-2rX_r\, X_\theta = I\{w^2\phi(w)\}$, [I ($z$) = imaginary part of z] is a potential function in B and from the above condition $\int_0^{2\pi} \lambda(r, \theta)\, r\, X_r\, X_\theta d\theta \to 0$ as $r \to 1$, it is proved that $r\, X_r\, X_\theta$ vanishes identically in B. Since the imaginary part of $w^2\phi(w)$ vanishes this function must be real and constant in B, *i.e.*, $w^2\phi(w) = C$, $\phi(w) = C/w^2$; but $\phi(w)$ is regular at $w = 0$ and so $C = 0$, *i.e.*, $\phi(w) = 0$ which expresses the character of S as a minimal surface. Therewith is solved Plateau's problem for $k = 1$. It must be noticed that incidentally for $m = 2$ when Γ is a Jordan curve in the x, y-plane, we obtain Riemann's mapping theorem (a remark due to Douglas.)

For $k > 1$ certain additional conditions are required to prevent the degeneration of the domain B. On the basis of some fresh lemmas on the lower limits of D (X), the solution of Plateau's problem for $k = 2$ is first given and then the solution for the general case $k > 1$ is constructed, by assuming that the problem has been solved for all lower values of k. As before general theorems on conformal mapping of multiply—connected domains result as bye-products of the reasoning. In the latter part of the paper, Courant also gives an alternative and considerably simplified solution by making use of fundamental facts concerning conformal mapping of domains in a plane, and proves that his solution of Plateau's problem furnishes at the same time the surface of least area bounded by Γ.

We await the further papers of Prof. Courant with great interest.

V. R. T.

The Royal Botanic Garden, Calcutta.*

THE Royal Botanic Garden, Calcutta, was founded in 1787. Lt.-Col. Robert Kyd, Col. of the East India Company's Engineers and of the Bengal Infantry, Secretary to the Military Board in Calcutta, proposed to the Government in Calcutta to establish a botanic garden on the 1st June 1786. The East India Company was still a Trading Company and this proposal to form a botanic garden was recommended to Sir John Macpherson, Governor of the Company's Settlements in Bengal, on the ground that by its means, might be introduced cultivation of Teak and Malayan specimens into a province near one of the Company's chief centres. Kyd was an ardent horticulturist and was a man of great energy and shrewdness. He held a position of considerable influence in those days. His suggestion was promptly taken up by the Government of Bengal. Without further delay they secured with the subsequent approval of the Court of Directors in England, the present site recommended by Kyd covering 300 acres. The Garden was henceforth the property of the Hon'ble Company but under the control of the Governor-General in Council. It is thus known locally as "Company Bagan". When the Hon'ble East India Company was dissolved, all its rights, duties and privileges were assumed by the Crown and the Garden became Her Majesty's Botanic

The Palm Avenue, Botanical Garden, Calcutta.

Garden. Apparently on the constitution of the Province of Bengal in 1834, the control of the Garden passed on to the local Government. The epithet Royal came to be applied to it after the Queen's Proclamation of 1857.

The whole of the area with the exception of 27 acres which was given up to Bishop Middleton for an English College still continues under cultivation as Botanic Garden. This Bishop's College was subsequently converted into the neighbouring Bengal Engineering College.

William Roxburgh who is rightly called "the father of Indian Botany" succeeded Col. Kyd, the Hony. Superintendent, in 1793 as the first official superintendent. Roxburgh's *Flora Indica* and his *Icones*, formed the basis of all subsequent works on Indian Botany. In the course of this short contribution, it would not be possible to narrate the monumental works on Indian Botany of the galaxy of brilliant botanists who followed Roxburgh; the names and the years of their services are given below:

Dr. Francis Buchanan (afterwards Sir Buchanan Hamilton)	.. 1814–1816
„ Nathaniel Wallich	.. 1817–1846
„ William Griffith (*Offg.*)	.. 1846–1848
„ McClilland (*Offg.*)	.. 1848
„ Hugh Falconer	.. 1848–1855
„ Thomas Thomson	.. 1855–1861
„ C. B. Clarke (*Offg.*)	.. 1869–1871
Sir George King	.. 1871–1897
Sir David Prain	.. 1897–1905
Col. A. T. Gage	.. 1906–1923
Mr. C. C. Calder	.. 1923 to date.

As it is often asked what economic purpose the Garden serves, a brief mention of the part played by this beneficent department of the Government may be of value.

No small part of the benefits conferred on the country by the Garden in its early days was the demonstration by practical experiment that certain natural products, many of them of a most desirable kind, cannot be grown in Bengal; much money and bootless effort being thus saved to the country. The cultivation of the teak tree, for the sake of its timber, then so invaluable for ship-building, was also begun on a large scale and was continued for 35 years, by which time it became clear that, although the tree to all outward appearance grows well on the muddy soil of the Gangetic Delta, its stems become hollow near the base, and is incapable of yielding sound timber of large scantling. The introduction of exotic timber trees also received early attention; and in the Garden there still remain a few of the original mahogany trees introduced in these early years. The introduction of tea was one of the items put down in Col. Kyd's original programme; and in the final establishment of what has now become one of the most important industries in Northern India, the Garden bore a most important part. Potato-growing was initiated by the agency of this Garden. The cultivation of the quinine yielding cinchonas of the Andes was originated and carried to a successful issue in the plantation and factory in the Darjeeling District, and the Government Hospitals and Dispensaries have for years been and still are being, supplied from this source. In the improvement of Indian cotton, and in the introduction both of that and of jute to the markets of Europe, the Garden authorities worked cordially hand in hand with the Agri-Horticultural Society of India; with what success it is unnecessary to point out. By the introduction of some of the best kinds of sugarcane from the West Indies, and the dissemination of these to all parts of the country, a considerable improvement was effected both in the quality and quantity of sugar crop of the country. In this matter also the Agri-Horticultural Society worked hand in hand with the Garden authorities. Very soon, after the establishment of the Society just mentioned, a considerable piece of land in the Garden was made over to it rent-free, and on this land the Society conducted the greater part of its operations for 40 years. In fact, it was not until the year 1872 that the Society's garden was transferred to its present site in Alipore. It

* The 150th anniversary of the foundation of the Royal Botanic Garden was celebrated on the 6th January 1938.

is unnecessary to discuss in detail the numerous experiments in the cultivation of economic plants which have been and are still being conducted in the garden since its beginning. A few of the products tried may simply be mentioned. Chief among these are flax, hemp, rhea or ramie, tobacco, henbane, vanilla, coffee, India-rubber, Japanese mulberry, cardamoms, tapioca and cacoa. As regards horticulture, it may suffice to say that a large proportion of the kinds of exotic plants now found in private gardens in India have been introduced into the country through the agency of this Garden, and that the improved methods of cultivation were to a great extent initiated here.

The Garden containing about 13,000 species under cultivation, offers enormous opportunity for the study of the tropical flora. These are arranged regionally over the whole area which are divided into 25 working divisions.

The Garden with the Herbarium and Library offers valuable materials for study of Indian plants in detail and tropical flora in general both in its dried and living state.

Thus in the long history of the Garden its usefulness has been for the benefit of India as a whole—not merely for Bengal. The scientific results obtained and the monumental publications of the *Annals* of the Royal Botanic Garden, Calcutta, are of world-wide interest. The collections of the herbarium are incomparably the most valuable scientific collections of their kind in Asia and one of the most valuable in the world. The Herbarium with the library is fittingly situated in the Garden. The collections of the Herbarium dates from Roxburgh's time. The approximate number of sheets in the Herbarium is estimated to be about two and a half million. These are arranged according to Bentham and Hooker's *Genera Plantarum*. All the precious collections of India, Burma and a fair number of plants of those of Asia outside India, Europe and Australia, also a few of Africa and America are housed in the Herbarium. The provincial floras are stocked in almirahs situated in the northern wing. The southern wing is mainly occupied by the Library. The Library contains nearly 2,500 volumes and some of the oldest botanical periodicals, the full set of the irreplaceable Roxburgh's *Icones*. The present Herbarium building is damp-proof and fireproof and was erected specially for the purpose by the late Sir George King in 1883 for housing securely the irreplaceable collections.

The Chemistry of Sesquiterpene Ketones.*

ALTHOUGH the terpenes have been extensively studied during the last fifty years it is only within the last decade that the sesquiterpenes and their derivatives received the attention of chemists. With the exception of doremone described by Semmler in 1917, no sesquiterpene ketones were known to occur in volatile oils till 1932 and their isolation opened up an interesting field of research. Eremophilones from the wood oil of *Eremophila mitchelli* were the first series of sesquiterpene ketones to be isolated[1] and were found to belong to the eudalin group. Eremophilone forms an epoxide with alkaline H_2O_2 and gives a hydroxymethylene derivative thus showing the presence of the grouping $-CH_2-CO-CH:CH-$. An isopropenyl side chain was indicated in eremophilone and in hydroxydihydro-eremophilone and an isopropylidene in hydroxy-eremophilone. The naphthalene hydrocarbon obtained by treating eremophilone with Grignard's reagent and selenium was found to be not 1 : 3-dimethyl-7-*iso*propylnaphthalene as per eudalene structures thus throwing a doubt on the presence of the angular methyl group. The new structures adopted are allied to the ionones and resin acids and are under investigation. Shortly afterwards in 1934, St. Pfau and Plattner[2] described two ketones α-atlantone and β-atlantone occurring in Atlas-cedar wood oil. Their presence in the oil had been overlooked previously since α-atlantone is hydrolysed readily by alkali. The formula assigned to these are based on degradation of atlantones to α-acetyl-dipentene and 4-methyl-Δ^3-tetrahydro-acetophenone. The presence of a small quantity of γ-atlantone was also concluded by formation of 9-acetyl-terpinolene with potash.

Closely related to these two ketones but of an aromatic type are the sesquiterpene ketones turmerone and *ar*-turmerone present in admixture in the oil obtained from the tubers of *Curcuma longa* which have been worked out with great ingenuity by Rupe, Clar, St. Pfau and Plattner.[3] Recently, B. Sanjiva Rao has isolated from the oil present in the tubers of *Cyperus rotundus*, a sesquiterpene ketone α-cyperone which like eremophilone is a derivative of eudalene. It is stereoisomeric with β-cyperone, the two ketones differing from each other in the disposition of the angular methyl and isopropenyl groups and related to each other as menthone and isomenthone. Cyperones have recently been synthesised at Oxford by Prof. Robinson and at Bangor. The very elegant method, so very characteristic of Oxford laboratories, in recent years gave an optically active α-cyperone.[4] Although the synthetic cyperones differed somewhat from the natural products, there appeared to be little doubt that the products had identical structure. The importance of the synthesis lies in the fact that it definitely establishes for the first time the presence of the angular methyl group in cyperones and in compounds of the eudalene type. This is of significance in connection with the eremophilones already referred to.

Though the analytical chemist's methods and weapons have reached a stage of perfection that it cannot be said with the same force, as was said some years ago, that a proof of a particular structure lay in its synthesis in the laboratory. There is no doubt however synthesis plays its own part in some doubtful cases as the above. With compounds of increasing complexity, the

* Synopsis of an address delivered by Professor J. L. Simonsen, D.Sc, F.R.S., at the Indian Institute of Science on 13th January 1938.

[1] Bradfield, Penfold and Simonsen, *J.C.S.*, 1933, 2744.

[2] *Helv. Chim. Acta.*, 1934, 17, 129.

[3] *Ibid.*, 1934, 17, 372.

[4] Adamson, McQuillin, Robert Robinson and J. L. Simonsen, *J.C.S.*, 1937, 1576.

number of isomers represented by the structure becomes unduly large, so that it becomes scarcely possible for the synthetic chemist to obtain a product identical with the one in question.

Two outstanding problems in terpene chemistry remain to be solved, the mechanism of the formation of terpenes in plants and the part they play in plant metabolism. It is simple on paper to derive any terpene from geraniol or linalol but there seems to be little justification for such a procedure. In many theories the assumption is made that the more complex terpenes are built up from the simpler. It is more probable however that the simpler terpenes originate with the degradation of the polyterpenes and resin acids, similar to starch being the progenitor of the simpler saccharides. Our knowledge of the chemistry of these is still too limited however for the elaboration of any definite scheme.

Physiology of the Individual in the Tropics.*

THE address of Bt. Col. R. N. Chopra can conveniently be divided into two parts: the first part deals with the general principles involved in the phenomenon of adaptation; and the second part deals with the physiological adaptive reactions produced in the individual under tropical climate.

"The objective of human physiology is the study of 'normal' individual." But the term normality is a relative condition, as the human individual is influenced by the environment which is in itself a variable factor and which is continuously changing in different parts of the globe. Hence there is a necessity to find out the normality of the individual in relation to his environment. Importance of this aspect of study drew the attention of scientists from time to time even from prehistoric days until the advent of the science of bacteriology in the latter part of the nineteenth century, when it lost its significance.

Man reacts to forces of nature, which tend to disturb the physiologic equilibrium, by "continuous adjustment of internal relation to external relations". He adapts himself "to live best under varied environmental conditions". The physiological equilibrium is of a dynamic and oscillatory nature and is the resultant of the reactions of the body to various internal and external stimuli. The adjustment is brought about by development of compensatory mechanisms so as to mobilise the reserve forces in the individual. Depending on the degree of such adjustments, the power of adptation can be made to be set at a high level by previous "training".

Chemical, hormonic and nervous mechanisms, being the means of adaptation to environment, operate singly or conjointly. With the development of reason the nervous adaptive reactions become more 'complex, conscious and volitional'.

Of the environmental conditions in the tropical plains, the temperature, humidity and sunlight are the important climatic factors. They produce reactions on the various systems of the body, and the resultant effect may be the summation of these reactions.

The exact way in which the beneficial biological effects are produced by the sunlight is not clear. High humidity has not much direct effect but when associated with high temperature adversely affects the individual by preventing heat-loss through evaporation. High external temperature does not seem to have an effect on body temperature.

The temperature of the living body is maintained constant by balancing the production and loss of heat. Neither the relatively high humidity of the atmosphere nor the concentration of sweat glands in the skin play an important part in heat loss. The composition of sweat, by lowering its salt concentration becomes altered as a measure of adaptation, when there is an excess of its excretion to lose body heat. The other adaptive measure concerned in regulating heat-loss is the development of a deep pigment in the skin.

The effect of tropical climate on gastro-intestinal tract is to produce an atonic condition with the resulting stasis and constipation. Possibly, this is due to reflex vaso-constriction in the viscera with increased vasodilatation in the skin. That the gastric acidity is much diminished due to temperature in tropical vegetarians is practically disproved. The bacterial flora of the intestine becomes changed due to high external temperature on the one hand and the rich carbohydrate diet on the other.

A change in depth but not in rate of respiration occurs as an adaptation, during acclimatisation in tropics. The rate and depth of respirations of a native of tropical plain do not differ from those of a person of temperate climate.

Changes in blood pressure and pulse-rate are relatively insignificant. Blood volume increases as a compensatory measure to restore the diminished blood supply to viscera. The only significant change in the hæmatological standards is a slight decrease in white blood corpuscle count, particularly a decrease in polymorphs and a noticeable increase in eosinophiles. Marrow stimulation is suggested by a shift of Arneth count to the left. Plasma concentration is greater, water being held in corpuscles. Proteins and lipoids decrease and calcium increases in plasma.

The reported psychological changes in tropical climates are probably due to causes other than climate. The absence of any definite evidence indicating changes in the nervous system does not preclude the possibility of subtle changes in the nervous system of the young.

The metabolism, energy level and resistance to infection are lowered and the cause is attributed to the hypo-activity of Thyroid-Adrenal apparatus. Sex-glands are said to be less active in tropics.

Associated with the metabolic function is the problems of diet in tropics. The greater part of available food is of vegetable source. The diet of the natives of the tropics is one containing plenty of carbohydrates, relatively small quantity of proteins of vegetable origin and of low biological value and practically no fatty acid which is of great value in growth and nutrition. Though this type of diet got up probably from custom, seems to be well adapted for tropical climate. But there is a necessity

* Summary of the Presidential Address of Bt. Col. R. N. Chopra, Physiology Section, Indian Science Congress, Calcutta, 1938.

to find out the proper amount of protein of biological value that is to be added to this diet.

The high temperature and humidity of tropical climate seems to lower the resistance of the gastro-intestinal tract and nasopharynx to bacterial infections. Possibly the sudden change that is more responsible than the climate itself.

With regard to immunological reactions under tropical conditions, more work is to be done.

In the concluding remarks of the address, attention is drawn to the salient features of the address and to the fields in which further work is to be carried to supplement the scanty information available on those topics.

Zoology and its Advancement in India.

ZOOLOGY and its advancement in India was chosen by Prof. G. Matthai as the subject of the Presidential Address before the Section of Zoology, as the Indian Science Congress celebrated its Silver Jubilee at the 1938 Session in Calcutta. The address dealt with the progress of Zoology since the foundation of the Indian Science Congress in 1914, more particularly since 1921.

Oceanographical investigation of the Indian Ocean was conducted, since the first meeting of the Indian Science Congress, mainly by R.I.M.S. '*Investigator*' (till 1926) and the John Murray Expedition (1933–34), under the direction of Lt.-Col. Seymour Sewell, F.R.S. Previously the 'Sea-lark' Expedition, under the leadership of Prof. J. Stanley Gardiner, F.R.S., had surveyed the western Indian Ocean south of the Maldives, more particularly the Islands of the Chagos Archipelago and the Mascarene region (during 1905–06 and 1908–09). The work of the 'Sea-lark' Expedition was mainly on problems relating to coral reefs and atolls and their biology, and was a continuation of a previous study of the Maldives and Laccadives. The R.I.M.S. '*Investigator*' concentrated its work in the Andaman Sea and the Bay of Bengal. The recent work of the John Murray Expedition was in the region of the Arabian Sea, not covered by the 'Sea-lark' Expedition. The study of the Deep-sea Biology of this region was assisted by physical, chemical, hydrographic and topographic investigations. The Survey of India collaborated with the John Murray Expedition in the cruise down the Maldives for making pendulum observations with a view to determining the nature of the foundations on which the Maldives and Laccadives are situated.

The work of the R.I.M.S. '*Investigator*' has extended our knowledge in regard to variation in the air temperature over the open waters of the Indian seas, in the wind force, in the amount of rainfall and in the relationship between the tempearture of the sea surface and that of the air. There is always a vertical circulation of the layers of water caused largely by differences in tempearture and salinity. A reversal of seasons is noticeable in the Indian seas at a depth of about 100 fathoms, comparable to the phenomenon that takes place in the temperate seas.

The 'Murray Ridge' discovered by the John Murray Expedition appears to be ultimately connected with the Carlsberg Ridge. The latter ridge divides the western region of the Indian Ocean into north-eastern and south-western halves. 'King Fuad Bank' is probably a submerged atoll with a distinct rim about 40 feet high and a level floor 130 fathoms deep.

Regarding the reefs of the Western Indian Ocean, Prof. J. Stanely Gardiner, F.R.S., recently pointed out that the Mascarene region differs from the Chagos Archipelago in regard to conditions of reef-growth, changes adverse to reef-growth taking place at a much faster rate than in the latter. The regression of coral reefs in the Mascarene region does not appear to be due to any biological reason such as sedentary organisms that cause destruction by boring into the reefs, since the activity of such organisms is decreased at the depths at which reefs of this region are situated, nor by sediment which cannot settle on the seaward sides of reefs and banks nor by precipitation of calcium carbonate (for such precipitation is not visible on coral polyps on the seaward sides), nor by currents whose action is less on the sides facing the sea, nor by temperature which at 50 fathoms is not lower than 61°·9 F., nor by any decrease in the amount of plankton that serve as food material to coral polyps, for it is not liable to much quantitative variation in the Indian Ocean, nor does the chemical composition of the surface water in the Indian seas show any appreciable difference. The comparative poverty of the deep sea fauna in the Chagos and Mascarene regions is perhaps due to the hardness of the sea floor and to the fact that the quantity of plankton which serve as food material to the larger organisms is less than in the Indian seas than in the temperate regions. In spite of the 'shallow and fierce conditions' of life on the reef of these regions, it is interesting to observe that the animals do not exhibit any special structural features that may be regarded as adaptations to the peculiar environmental conditions.

The Madreporarian corals collected by Prof. J. Stanley Gardiner, F.R.S., in his several expeditions to the Indian Ocean, particularly of the Astræid corals, provided material for a comparative study, of the morphological organisation of their hard and soft parts, with a view to determining, if possible, the limits of species and genera, most previous taxonomic studies on corals having been based on characters taken solely from the hard parts that are liable to considerable variation. The same material, along with others, formed the basis for a study of colony formation in Astræid corals.

The Zoological Survey of India has been engaged mainly in faunistic investigation, more especially of the brackish water of the Chilka Lake and its island (Barkuda), the estuarine fauna of Goa, the fauna of the Mutlah River, of the Inle Lake, the Indian fresh-water Molluscs and their Trematode parasites, the aquatic and terrestrial fauna of the Punjab Salt Range, the cave fauna of the Siju Cave in Assam. Particular attention has been paid to the study of the fishes of hill streams in various parts of India and their structural and other adaptations to this peculiar environment. Fisheries research, especially on *Trochus*, was conducted in the Andamans.

The address ends with a brief account of the research work carried out in the various Zoology Departments in India.

SCIENCE NOTES.

Exceptional Viviparous Germination of Seeds in *Cassia occidentalis* and *Tephrosia purpurea*.—Mr. J. Venkateswaralu, Andhra University, Waltair, writes.—*Cassia occidentalis* Linn. and *Tephrosia purpurea* Pers. are two very common weeds at Waltair. They grow very abundantly in fields and waste lands. At some places in the Andhra University area they are found in very large numbers and cover the ground so thickly that it is very hard for any other plant, except *Croton sparsiflorus* and a few grasses, to grow there. The usual method of propagation of these two leguminous species is by seeds, which when ripe fall to the ground and germinate under favourable conditions. Both the plants flower and fruit roughly from June to January.

In the first week of October 1937, there was continuous cloudy weather and rain at Waltair. On the whole, the atmosphere was warm and more humid than usual. At that time there was a good number of mature and undehisced pods on *Cassia occidentalis* and a few on the plants of *Tephrosia purpurea*. Due to the change in the environment the seeds of almost all the mature pods on *Cassia occidentalis* got wet and germinated. The radicles were the first to appear. In about two days the process proceeded further and complete seedlings were formed. This was observed to occur on almost every plant out of the many hundreds growing in the area. Some such pods with completely formed seedlings were broken off by wind and carried to a small distance by the flowing rain water. While the above described atmospheric condition lasted the seedlings were successful in establishing themselves in the soil and continued to grow into small plants. But after 3 or 4 days the normal conditions revived and the many seedlings left on the plants withered away and died due to the heat of the sun. A search to see if similar vivipary was also induced in other species growing in the neighbourhood revealed the same in *Tephrosia purpurea*, though it was only seen in a few cases. This was probaly due to the fact that the pods of this species were not yet fully ripe. Further, in this case only radicles were given out.

The above behaviour of seeds of *Cassia occidentalis* and *Tephrosia purpurea* is very similar to the exceptional occurrence of vivipary in *Atriplex crassifolia* and *Suæda fruticosa* described by Joshi[1] (1932). Other cases of dry fruits the seeds of which do not ordinarily germinate *in situ*, but do so when the temperature and humidity of the surroundings are high as cited by Tiwary[2] (1935) are: *Dryobalanops camphora*, wheat grains on the stalk, *Ipomea glaberrima*, *I. peltata*, *Hibiscus diversifolius*, *Croton* sp., *Luffa cylindrica*, *Juncus* sp., *Epilobium* sp., *Agrostemma* sp., *Papaver somniferum*, *Tetranema mexicana* and *Avena sativa*.

[1] Joshi, A. C., *J. Ind. Bot. Soc.*, **1932**, **11**, 71.

[2] Tiwari, N. K., *J. Bom. Nat. Hist. Soc.*, August **1935**.

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A Modified Method of Bagging Plants.—Mr. S. M. Patel, Cereal Breeding Station, Kundewadi, Niphad, writes.—"One of the usual methods of protecting plants is to enclose either a branch or the whole plant under a muslin cloth bag kept distended by iron-rings. To hold the bag in place it is suspended from a bamboo post provided with an arm. At some places the bags are suspended from overhead wires stretched across the experimental plot.

The method of tying the muslin bags to a bamboo post was being followed at the Cereal Breeding Station, Niphad. It was, however, found that when the winds blew heavily the bags in use would shake violently, damaging the branch or the plant as the case may be. Strong winds prevail for a considerable period at the Station, and the constant upward pull of the enclosing bag has a destructive effect. The soil at Niphad is heavy and cracks badly which makes it difficult to keep the bamboo posts straight as they cannot be driven deep enough in the soil. The result is that with the advent of a strong wind or a storm the posts become loose and in many cases fall off. To overcome these difficulties, round iron bars of half an inch in thickness were substituted. An iron bar of such a size could easily be driven deep in the soil and thus would keep standing during a storm. Moreover, as the girth of such a bar is quite small, it can be planted near the stem of the plant. This enables the bag to be slipped over both the iron-stake and the plant. The lower end of the bag is tied around the stem of the plant and the bar, and the upper on to the top of the iron-stake. To prevent slipping, the bar is flattened just below the top and the string is tied above the expanded portion.

By using iron-stakes of sufficient length, tall plants like those of bajri can also be efficiently protected and prevented from lodging. Indeed we have also used the modification successfully with such crops as safflower, linseed, nigar, sesamum and tur (*Cajanus indicus*). On the whole the method is more suitable for short plants with rigid stems."

* * *

Science and Society.—At the one hundred and first meeting of the *American Association for the Advancement of Science* held at Indianapolis from December 27, 1937, to January 1, 1938, a few resolutions expressing the attitude of science on questions of public interest, were passed. The Association has been in existence for over 90 years, has an active membership of 19,000 and with its 165 affiliated and associated societies is representative of all sciences. The resolutions passed at the annual meeting compel the attention of the scientific public. The resolution regarding Science and Society reads as follows:—

"Whereas, science and its applications are not only transforming the physical and mental environment of men but are adding greatly to the complexities of their social, economic and political relations; and

"Whereas, science is wholly independent of national boundaries and races and creeds and can flourish permanently only where there is peace and intellectual freedom; now therefore, be it

"*Resolved* by the Council on this thirtieth day of December 1937, that the American Association for the Advancement of Science makes as one of its objectives an examination of the profound effects of science upon society; and that the Association extends to its prototype, the British Association for the Advancement of Science, and to all other scientific organizations with similar aims throughout the world, an invitation to co-operate not only in advancing the interests of science but also in promoting peace among nations and intellectual freedom in order that science may continue to advance and to spread more abundantly its benefits to all mankind."

* * *

The Agricultural Statistics of India.—The second volume of statistics, recently issued by Government of India (Department of Commercial Intelligence and Statistics, India, Manager of Publications, Delhi, 1937, pp. 336, Price Rs. 5-10) relate to the Indian States as distinguished from British India. It is explained in the introductory note that the statistics are neither complete nor accurate as those relating to British India. It will be noticed also that they are some three years old. Nevertheless as between the larger individual States themselves or groups of States the figures afford some interesting comparison to which attention may be drawn. The States taken together comprise one-third of the whole of India in extent and possess about one-fifth of the population of India. The premier States of Hyderabad, Kashmir, Mysore and Gwalior are about 53, 52, 18 and 16 million acres respectively while the important States of Baroda, Indore and Travancore are only 5, 6 and 4 million acres respectively. In the proportion of cultivated areas to the total areas, Hyderabad and Baroda return about 62 and 60 per cent. as cultivated; Gwalior, Kashmir, Mysore and Travancore return 25, 27, 30 and 42 per cent.; while Kashmir only about 4 per cent. The group of the Punjab States has the largest irrigated area, quite 60 per cent. of its total cultivated area being under irrigation, while Mysore has 16 per cent., and Hyderabad, Baroda and Kashmir between 3 and 4 per cent. only. As regards the area under the different important crops Hyderabad occupies the pride of place in its large extent; rice, wheat, jowar, bajra, oil-seeds and cotton account for 1·1, 1·2, 8·9, 2·1, 3·1 and 3·1 million acres respectively. The largest wheat areas are furnished by Hyderabad, by the Central Indian States and the Punjab Agency States, while Mysore is unique in respect of ragi which occupies 30 per cent. of its total cultivated area. The States also exhibit interesting special peculiarities by virtue of their situation or of tradition; thus Mysore and the Madras States are the only ones growing cocoanuts with 1·6 and 6·3 lakhs of acres respectively; these are moreover the only coffee and tea growing States, Mysore leading in coffee with over a lakh of acres while the other States lead in tea with a little over ¾ lakh of acres. The sugarcane area is nowhere very much over half a lakh of acres, Hyderabad has about 50,000, Mysore over 45,000 and the Punjab States about 54,000 acres. For its total cultivated area Mysore has also the largest area under tobacco; thus for every 1,000 acres of cultivated area, Mysore has 3·7 acres, Hyderabad 3 and Baroda less than 1·7 acres under tobacco.

The statistics include in addition information regarding the incidence of land revenue assessment with reference to the area and population as well as a census of the livestock and agricultural implements of the different States.

* * *

In a note appearing under the news and views columns of *Nature* (February 5, 1938, p. 238) attention is drawn to the settlement of a claim of £ 750,000 preferred by a company against the University of Oxford by a payment of £ 70,000. In 1926, Dr. B. T. Owen, Director, Institute of Research in Agricultural Engineering, sold to the plaintiff company a patent relating to the extraction of sugar from beet, which proved worthless, resulting in heavy loss to the company. The company believed that the Director was throughout acting as the agent of the University. Following the conviction of B. T. Owen, the University had to agree to pay £ 70,000 and arrive at a satisfactory settlement.

* * *

National Academy of Sciences.—The Seventh Annual Meeting of the Academy was held on the 5th March in the Vizianagaram Hall of the Allahabad University, Pandit Jawaharlal Nehru presiding.

Dr. D. L. Srivastava presented the annual report on the working of the Academy for the year 1937. Prof. Birbal Sahni, F.R.S., the President of the Academy, delivered an address on "Evolution or Revolution in Plant Work".

Dr. M. R. Siddiqui, Professor of Mathematics, Osmania University, Hyderabad, was awarded the Educational Minister's Gold Medal, his paper published in the *Proceedings of the Academy*, having been adjudged to be the best in Mathematics and Astronomy.

A conversazione on the problem of Power Supply in the United Provinces, was held in the Physics Lecture Theatre. The discussion was initiated by Prof. M. N. Saha, F.R.S.; Prof. N. Godbole, Dr. N. G. Chatterji, Mr. B. P. Aderkar, and others took part in the discussion.

In the course of his address, Pandit Jawaharlal Nehru said, "I should like an aggressive and wide-spread tackling of our problems by experts. I should like permanent museums for the education of our masses especially of peasantry, to grow up in every district." The Pandit wanted the governments and scientists of India to co-operate and work to the fullest advantage of the country.

* * *

The Fourth Annual Meeting of the Indian Physical Society was held on the 5th January 1938, in the Physics Lecture Room, Baker Laboratories, Presidency College, Calcutta, with the President Prof. M. N. Saha in the Chair. Sixty

Fellows and a large number of visitors were present.

Before the proceedings of the meeting commenced, a resolution expressing condolence at the sad demise of Lord Rutherford of Nelson and Sir Jagadis Chandra Bose, was moved from the Chair and passed.

After the President's introductory remarks, Prof. Sir Arthur Eddington delivered an address on " Scattering of Protons by Protons ". Prof. W. Bothe of Heidelberg, then read a paper on " Cosmic Ray Showers ".

The following were elected Office-bearers of the Society for the current year :

President : Dr. S. K. Banerji, D.Sc. (Poona). *Vice-Presidents* : Prof. D. M. Bose, M.A., Ph.D.: (Calcutta) ; Prof. G. R. Paranjpe, M.Sc. (Bombay) ; Prof. M. N. Saha, D.Sc., F.R.S. (Allahabad) ; Prof. H. P. Waran, D.Sc., Ph.D. (Travancore). *Secretary* : Prof. S. K. Mitra, D.Sc. (Calcutta) ; *Treasurer* : Prof. P. N. Ghosh, Ph.D., Sc.D. (Calcutta). *Members of the Council* : Mr. S. K. Acharya, M.Sc. (Calcutta) ; Prof. A. C. Banerjee, M.A., M.Sc. (Allahabad) ; Prof. S. N. Bose, M.A. (Dacca) ; Dr. B. N. Chukerbutty, D.Sc. (Calcutta) ; Dr. P. K. Kichlu, D.Sc. (Lahore) ; Dr. D. S. Kothari, Ph.D. (Delhi) ; Prof. K. Prasad, M.A., M.Sc. (Patna) ; Dr. K. R. Rao, D.Sc. (Waltair) ; Prof. N. C. Ray, M.A. (Calcutta) ; Principal B. M. Sen, M.A., M.Sc. (Calcutta) ; Prof. N. R. Sen, Ph.D., D.Sc. (Calcutta) ; Prof. M. R. Siddiqui, Ph.D. (Hyderabad-Deccan).

* * *

The Indian Lac Cess Committee have recently published the *Report* for the period 1st April 1936 to 31st March 1937. The resources of the Indian Lac Cess Committee have been augmented by increasing the cess on lac. Steady progress in research is made at the Indian Lac Research Institute and in the laboratories of the United Kingdom. The Indian Lac Cess Committee has been reconstituted and the shellac manufacturing, exporting and consuming interests are well represented on the Committee.

* * *

We have received a copy of the *Annual Report of the London Shellac Research Bureau* for the financial year, 1936-37. The first triennium for lac research in the United Kingdom ended on June 30th, 1936, and the Indian Lac Cess Committee decided to transfer the lac research staff from the Paint Research Station, Teddington, to an independent Lac Research Laboratory. Through the courtesy of the University College of London authorities, it was housed in the Chemical Engineering Department of the University College. By February 1937, research work was fully organised with Professor H. E. Watson and Mr. M. B. Donald of the University College, London, in supervisory charge.

The Special Officer, Lac Inquiry, Mr. A. J. Gibson, continued his valuable work of disseminating knowledge of lac by means of personal contacts, articles in the European technical Press, exhibitions, and correspondence in addition to propaganda tours.

* * *

Andhra University.—The Syndicate, on the recommendation of the examiners appointed to adjudicate on the theses submitted to the University has resolved that the following persons be declared to have qualified to receive the degrees noted below :—

Degree of Doctor of Philosophy (Ph.D.) : Mr. K. Neelakantam, M.A. ; Subject of thesis : " Pigments of Flowers ".

Degree of Master of Science, Honours (M.Sc., Hons.) : Mr. P. Pattabhiramayya, M.A. ; Subject of thesis : " Scattering of Light in Crystals and Simple Molecules in Relation to their structure ".

Degree of Master of Arts, Honours (M.A., Hons.) : Mr. N. Rama Rao, B.A. (Hons.) ; Subject of thesis : " Theory of Numbers ".

Degree of Master of Science (M.Sc.) : Mr. Ch. V. Jogarao, B.A.; Subject of thesis : " Scattering of Light in Viscous and Associated Liquids ".

* * *

Delhi University.—His Excellency the Chancellor of the Delhi University is pleased to reappoint the Hon'ble Kunwar Sir Jagdish Prasad, K.C.S.I., C.I.E., O.B.E., as Pro-Chancellor of that University, for a period of three years with effect from 2nd April 1938.

* * *

Osmania University.—The Annual Convocation was held on Tuesday, March 1, the Rt.-Hon'ble Sir Akbar Hydari, presiding. Dr. C. R. Reddi delivered the convocation address.

The Chancellor announced that the University of Oxford had approved for the purpose of senior status, the Osmania University M.A. in first class.

In the course of his address, Dr. C. R. Reddi said : " I beg to congratulate the Sovereign Government and Dominions on the success achieved by the University band of young, accomplished and enthusiastic teachers comprising different faculties, a team which the greatest educationists of India would be proud to captain. Researches were accomplished and were going on and investigations in theoretical and applied field of science including zoology, physics, chemistry, civil engineering and mechanics augur not merely an all-India but international future, for, Osmania University was the first to recognise an Indian language as a fit medium for University culture. These are accomplishments for which India must eternally be grateful to the Dominion."

As many as 151 successful students were admitted to the various degrees of the University.

The total number of students in all the departments of the University, including the affiliated Intermediate colleges is 1,379 as against 1,279 in the previous year. The ideal aimed at, is a Residential University with 800-1,000 students, all of them living in Hostels in the University premises at Adigmat. The Board of Research was reconstituted and a number of Research Fellowships of Rs. 75 per mensem, tenable for 2 years, have been created.

* * *

University of Mysore.—*Personnel*: Mr. B. Krishnaswami Aiengar, Principal, College of Engineering, Bangalore, was permitted to retire from service from 26th February 1938.

Extension Lectures.—(i) Dr. M. V. Gopalaswami, B.A., B.Sc., Ph.D., Professor of Psychology, Maharaja's College, Mysore, delivered a lecture in English on 'The Future of the Radio in India', at Bhadravati.

* * *

University of Travancore.—Mr. C. V. Chandrasekharan, now Director of Public Instruction, Travancore, and Pro-Vice-Chancellor, has been appointed *sub pro tem* Pro-Vice-Chancellor of the Travancore University.

The Government of India have lent the services of Mr. S. Kamesam, Timber Development Officer at the Forest Research Institute and College, Dehra Dun, to the Travancore Durbar for a period of three years. Mr. Kamesam has been appointed Director of Plant Development, University of Travancore.

* * *

Prof. A. B. Misra of the Benares Hindu University has been invited by the President of the *International Congress of Entomology* to attend the seventh session of the Congress to be held in Berlin in August 1938, and to participate in its deliberations. Prof. Misra has accepted the invitation.

* * *

Dr. H. Chaudhuri, D.Sc., Head of the Botany Department, Panjab University and Honorary Secretary of the Lahore Horticultural Society, has been appointed the First Chairman of Tropical and Sub-tropical Fruit-growing Section in the XII International Horticultural Congress, to be held in Berlin in August next.

* * *

Professor William Bragg, Director of the National Physical Laboratory, son of the eminent scientist, Sir William Bragg, has been elected to succeed the late Lord Rutherford, as Cavendish Professor of Experimental Physics, Cambridge University.

* * *

Sir J. J. Thomson, O.M., F.R.S., has been awarded the *Kelvin Medal* for 1938, in recognition of the eminent services he has rendered to engineering science.

Announcements.

Seventh International Congress of Genetics. In accordance with a resolution of the International Committee and with the decision of the Organising Committee elected by the Genetical Society of Great Britain, the SEVENTH International Congress of Genetics will meet in Edinburgh in 1939 probably from August 23rd to 30th inclusive.

Professor F. A. E. Crew, Institute of Animal Genetics, University of Edinburgh, has been appointed General Secretary to the Congress and to him all correspondence concerning it should be addressed.

Second All-India Obstetric and Gynaecological Congress.—The Second All-India Obstetric and Gynæcological Congress will be held at Bombay from 13–16 April under the Presidentship of Dr. B. D. Mukherji, Carmichael Medical College, Calcutta.

Particulars regarding the Congress can be had from—The Organising Secretary, "Raj Bhuvan," Sandhurst Road, Bombay 4.

* * *

An International Conference of Teachers, to discuss the actual problems of international relations to-day and to exchange ideas and experiences on the methods of teaching international relations and of promoting international friendship and understanding in the colleges and schools, will be held in London on April 22–25. Further information can be obtained from the Secretary, Education Committee, League of Nations Union, 15, Grosvenor Crescent, London, S.W.1.

* * *

Those interested in the insect life of India, will welcome news that the **Entomological Society of India** was inaugurated during the Silver Jubilee Session of the Indian Science Congress. Such an organisation was long overdue in India where insect fauna is so rich and varied and insect activity, both harmful and beneficial, has such an important bearing on the economic interests of the population. The Society, therefore, aims to promote the cause of Entomology in all its aspects and to co-operate with other organisations having a similar object, in India and abroad.

As in a vast country like India, it is very difficult for members to meet together oftener than once in the year, the Society has started branches in the following Entomological Centres:—

CENTRE.	SECRETARY.
Calcutta ..	Mr. D. D. Mukerji
Dehra Dun	Mr. N. C. Chatterji
Lyallpur ..	Dr. K. A. Rahman
Karachi ..	Rao Bahadur Ram Chandra Rao
Coimbatore	Rao Sahib T. V. Rama Krishna Ayyar
New Delhi ..	Dr. K. B. Lal

These branches will periodically hold meetings during the course of the year, and members from all parts of the country will meet together annually, usually with the Indian Science Congress. Other branches would be formed, if a sufficient number of members join the Society from any one place. Important papers read and bunsiness transacted at the various centres will be published in the *Journal* of the Society.

The admission fee is Rs. 10 and annual subscription is also Rs. 10. It is to be hoped that all those who are interested in any phase of insect activity will join the Society and increase its usefulness. Further information may be obtained from any one of the Branch Secretaries or from Dr. K. B. Lal, Second Assistant Entomologist, Imperial Agricultural Research Institute, New Delhi, who is acting as General Secretary and Treasurer of the Society.

Literary Intelligence.—Prof. Albert Einstein will shortly publish with the Cambridge University Press a new book for general readers entitled *The Evolution of Physics: The Growth of Ideas from the Early Concepts to Relativity and Quanta.* His collaborator is Dr. L. Infeld. The book describes the history of classical and modern physics since Galileo and Newton; it is written to make comprehensible to the layman, by following again the natural stages of thought in history, the present position in physics. It does in fact lead up to Einstein's own account of the great discovery of relativity. It is not the less serious and authoritative because it is addressed to those who are not physicists.

This important book, it is announced, is to be the first in a series, the Cambridge Library of Modern Science, planned by the Syndics of the University Press, to bring before the world in general explanations by great scientists of the state of discovery and theory in science at the present day.

* * *

We acknowledge with thanks, receipt of the following:—

"Agricultural Gazette of New South Wales," Vol. 49, No. 2.

"Journal of Agricultural Research," Vol. 55, No. 10.

"Agriculture and Livestock in India," Vol. 8, No. 1.

"American Museum of Natural History," Vol. 41, No. 2.

"The Philippine Agriculturist," Vol. 26, No. 9.

"Biochemical Journal", Vol. 32, No. 1.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 71, No. 2.

"Bulletin of Health Organisation (League of Nations)," Vol. 6, No. 6.

"Chemical Age," Vol. 38, Nos. 970-72.

Calcutta Medical Journal," Vol. 33, No. 2.

"Communications from the Kamerling Onnes Laboratory," Nos. 241-47.

"Current Titles from Engineering Journals," Vol. 2, No. 1.

"Experiment Station Record," Vol. 78, No. 1.

"Forschungen und Fortschritte," Vol. 14, Nos. 4 and 5.

"Transactions of the Faraday Society," Vol. 34, No. 202.

"Indian Journal of Physics," Vol. 11, No. 6.

"Journal of the Royal Society of Arts," Vol. 86, Nos. 4445.

"Journal of the Indian Botanical Society," Vol. 17, No. 1.

"Journal of the Institute of Brewing," Vol. 35, No. 2.

"Journal of Chemical Physics," Vol. 6, No. 2.

"Journal of the Indian Chemical Society," Vol. 14, No. 12.

"Journal de Chemie Physique," Vol. 34, No. 12.

"Journal of the Mining and Geological Institute of India," Vol. 33, Pt. 3.

"Journal of the Mining, Geological and Metallurgical Society of India," Vol. 9, Nos. 1-4.

"Journal of Nutrition," Vol. 15, No. 2.

"Journal of Research (National Bureau of Standards)," Vol. 19, No. 5.

"Medico-Surgical Suggestions," Vol. 7, No. 2.

"Nature," Vol. 141, Nos. 3561-63.

"Sky," Vol. 2, No. 4.

"Indian Trade Journal," Vol. 128, Nos. 1652-54.

Catalogue.

"Annual Table of Constants," Paris, No. 1, 1937.

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences:

February 1938. SECTION A.—K. NAGABHUSHANA RAO: *Theory of the Indian Musical Drums—Part I.*—The normal modes of vibration of a symmetrically loaded membrane, in which the surface density varies in inverse proportion to the radius, are discussed. The first four modes with nodal diameters only form an approximate harmonic sequence. A more widely distributed load should be necessary to reproduce completely the observations. P. L. BHATNAGAR: *On the Summability of the Conjugate Series of Fourier Series.* R. S. KRISHNAN: *Reciprocity Theorem in Colloid Optics. (Case of Oriented Particles.)*—The reciprocity relation is valid for the case of oriented non-spherical particles only if they are free to rotate about an axis perpendicular to the plane containing the incident beam and the direction of observation, or if, in the aggregate, they have random distribution in this plane. R. S. KRISHNAN: *Studies on Light-scattering in Emulsions:—Part I Dilute Simple Emulsions.*—It is shown that the droplets in dilute emulsions are spherical in shape and that the observed finite values of ρ_v and ρ_h are due to the existence of depolarised secondary scattering. B. R. SETH: *Transverse Waves in Canals.* G. V. L. NARASIMHA MURTY: *Colorimetric Estimation of Nitrate in the Presence of Nitrite.*—A method has been developed in which urea is employed for destroying nitrates. K. S. GURURAJA DOSS AND B. SANJIVA RAO: *A Theory of Contact Angles.*—The importance of adsorption in determining the contact angle is considered.—T. VENKATARAYUDU: *Ideal Theory of the Abelian Group-Algebra.* N. K. JOSHI AND S. C. DEVADATTA: *Studies in Three Component Systems:—Part I.—Systems Composed of Sulphuric Acid, Water and either Zinc Sulphate or Magnesium Sulphate.*—It is not possible to substantiate the claims of various workers for hydrates intermediate between the hexa and mono. *Part II: The System Composed of Zinc Sulphate, Magnesium Sulphate and Water.* C. S. VENKATESWARAN: *The Raman Spectra of Some Inorganic Compounds.*—Te $(OH)_6$ is shown

to be octahedral, CrO_4'', MoO_4'', WO_4'' and IO_4' ions as tetrahedral, ClO_3' and BrO_3' ions as pyramidal, and N_3 as linear and unsymmetrical in structure. A. NARASINGA RAO: *Through a Railway Window.*—The apparent twisting and writhing of a landscape as seen by a moving observer is described in the language of mathematics.

February 1938. SECTION B.—CAETANO CORREIA DE MEYRELLES: *Parasites of the Genus* Bertarellia *in the Blood of the Tortoises of India and Brazil.*—The three specimens of *Bertarellia* found in *Emyda granosa*, *Chelonia midas* and *Caretta-caretta*, appear to belong to the same species, and differ from *Bertarellia calotis*. It is designated *Bertarella carinii* n.sp. B. P. PANDE: *The Trematode Genus* Allocreadium *in North Indian Fresh-water Fishes.*—Two new species of *Allocreadium* obtained from *Gobius guiris* and *Barbus chilinoides* are described. T. P. VANAJAKSHI: *Histology of the Digestive Tract of* Saccobranchus fossilis *and* Macrones vittatus.—A detailed account of the structure of the digestive tract, based on studies of sections with details of gross anatomy for fresh material. M. K. SUBRAMANIAM: *Studies on the Structure of the Golgi Apparatus—II: Liver Cells of* Rhacophorus Maculatus Gray.—The hypothesis previously put forward regarding the probable mode of evolution of the network-like Golgi apparatus of vertebrate somatic cells from the discrete Golgi bodies of invertebrates, has been verified in the case of the liver cells of *Rhacophorus*. I. FROILANO DE MELLO AND LUIS LOBO: *On the Morphology and Identification of a Trypanosome found in the Blood of* Hemidactylus brooki *Gray.*

Indian Botanical Society:

March 1938.—A. B. SARAN: *A Note on Wounding of the Leaves of* Anacardium occidentale *Linn. at Different Stages of their Developments and its Effect on Respiration.* S. R. BOSE: *The Effect of Radiation on some* Polypores *in Culture.*

Indian Chemical Society:

December 1937.—SALIMUZZAMAN SIDDIQUI: *The Constituents of* Didymo-carpus Pedicellata.—*Part I: Isolation of a New Series of Colouring Matters.* SISIR KUMAR GUHA: *Studies in Indigoid Dyes—Part II.* TEJENDRA NATH GHOSH: *Quinoline Derivatives.—Part III.* R. C. SHAH, S. M. SETHNA, BHAVANI CHARAN BANERJEE AND DUHKHAHARAN CHAKRAVARTI: *Pechmann's Condensation of Methyl β-Resorcylate and β-Resorcylic Acid with Ethyl Acetoacetate.* BAIDYANATH GHOSH AND B. C. GUHA: *Ascorbic Acid Oxidase from the White Gourd* (Benincasa cerifera). DUHKHAHARAN CHAKRAVARTI AND SAILENDRA MOHON MUKHERJEE: *Synthesis of Coumarins from Phenols and Acetoacetic Esters. Constitution of Halogenated Resorcins and Orcins.* A. K. CHOUDHURY, P. DAS GUPTA AND U. BASU: *Studies on Sulphonamides.* N. L. PHALNIKAR AND K. S. NARGUND: *Influence of α-Phenyl Group in Three Carbon Tautomerism—Part I: Tautomerism of α-Phenyl-αβ-, βγ-unsaturated Acid and Esters.* S. S. DE AND B. N. GHOSH: *Studies in Adsorption of the Neurotoxin and Hæmolysin of Cobra* (Naja naja) *Venom by Various Adsorbents at different pH with a View to their Isolation.*

Errata.

Vol. VI, No. 6, *December* 1937.

Contribution entitled "*Cyclo*pentyl and *Cyclo*hexyl Succinic Acid and Resolution of *Cyclo*pentyl Succinic Acid":—

P. 278, column 1, line 7, *for* "b.p. 166°/mm." *read* "b.p. 166°/5 mm."

P. 278, column 1, line 7, *for* "b.p. 168°/45 mm." *read* "b.p. 168°/4–5 mm."

Vol. VI, No. 7, *January* 1938.

Review entitled 'The Naming of Plants':—

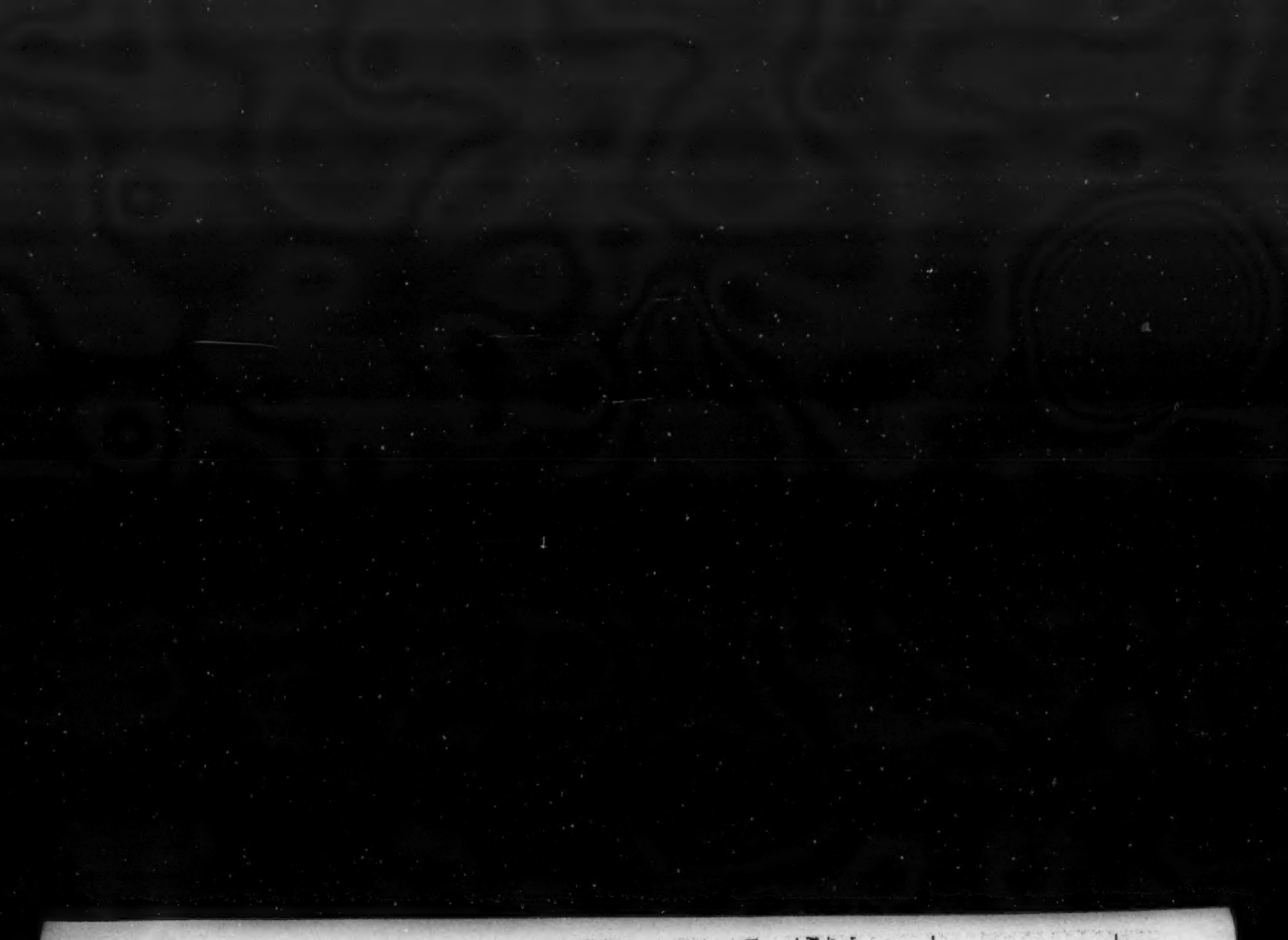
P. 346, *for* "(Chapman & Hall, Ltd., London)", *read* "(Edward Arnold & Co., London)".

P. 347, Review on "Polymerization and Its Technical Applications":—

Line 3, *for* "Reinhold Publishing Corporations, 1937, pp. 312 Price $ 7·50" *read* "Reinhold Publishing Corporation, New York, U.S.A., Chapman & Hall, Ltd., London, 1937, pp. 312. Price $ 7·50".

Vol. VI, No. 8, *February* 1938.

Contribution entitled "*Eupelmus tachardiæ* How., and the Lac Insect":—

P. 387, line 34, *for* "it" *read* "lac".

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